K14D Waves: Light and Sound: Exam Drill

AQA AQA KS3 Science · Calculator allowed · about 75 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State whether each example involves sound waves or light waves: 1) A person hears a dog barking in the street. 2) Sunlight passing through a window to brighten a room. 3) A submarine using sonar to detect objects underwater. 4) Seeing the colour of a flower.

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

(b) 2) Sunlight passing through a window to brighten a room. **(1)**

(c) 3) A submarine using sonar to detect objects underwater. **(1)**

(d) 4) Seeing the colour of a flower. **(1)**

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2 Tick whether the following statements are True or False and give a short reason for each tick: a) Sound can travel through solids. b) Light needs a material to travel through.

(a) a) Tick True or False: Sound can travel through solids. **(1)**

- ☐ True
- ☐ False

(b) b) Tick True or False and give a short reason: Light needs a material to travel through. **(1)**

- ☐ True
- ☐ False

3 A student times the delay between seeing lightning and hearing thunder. The delay is 6.0 s. Use speed of sound in air = 340 m/s. Calculate the distance to the lightning in metres. Give your answer to three significant figures.

(a) Distance = speed x time. Calculate the distance to the lightning. **(3)**

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4 Name the wave property described in each part. a) The distance between two neighbouring crests. b) The number of complete waves passing a point in one second.

(a) a) The distance between two neighbouring crests. **(1)**

(b) b) The number of complete waves passing a point in one second. **(1)**

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5 A ripple tank produces waves. A student measures the distance covering 6 wavelengths as 1.44 m. Calculate the wavelength of the waves in metres. Show your working.

(a) Wavelength = total distance / number of wavelengths. Calculate the wavelength. **(4)**

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6 A tuning fork produces a sound at frequency 440 Hz. A student hears a sound from a second tuning fork and measures its frequency as 452 Hz. Calculate the percentage difference in frequency between the two forks. Give your answer to two significant figures.

(a) Percentage difference = (change / original) x 100. Calculate the percentage difference using 440 Hz as the original. **(4)**

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7 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. b) If light hits a rough surface the reflection is called ____ reflection.

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

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

8 A class investigates how loud a sound is at different distances from a speaker. They record the following average sound level readings in decibels. Distance from speaker (m): 0.5, 1.0, 2.0, 4.0. Sound level (dB): 78, 72, 66, 60. a) Plot these values on a distance versus sound level table and describe the trend. b) Suggest one variable they should control to make the test fair.

(a) a) Complete a simple table with the given pairs and describe the trend in sound level as distance increases. **(3)**

(b) b) Suggest one variable to control to make the test fair. **(2)**

9 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. b) Explain in simple terms why the direction changes.

(a) a) Name the process. **(1)**

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

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10 A pupil measures frequency of a sound by counting 15 wave peaks in 0.025 seconds. a) Calculate the frequency of the sound in Hz. b) State one source of experimental error in this measurement and how it could be reduced.

(a) a) Frequency = number of waves / time. Calculate the frequency in Hz. **(3)**

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(b) b) State one source of experimental error and how to reduce it. **(1)**

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11 Extended response (6 marks). A student investigates how the angle of incidence affects the angle of reflection using a plane mirror. They shine a ray at different angles and measure the angle of reflection. Describe how to carry out a fair test, what results they should expect, and explain how those results support or contradict the law of reflection. Include variables to control and how to present the data.

(6)

12 A sound wave has wavelength 0.85 m and travels through air at 340 m/s. Calculate its frequency in Hz. Show your working and give the answer to three significant figures.

(a) Use the equation frequency = speed / wavelength to calculate the frequency. **(4)**

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Mark scheme · K14D Waves: Light and Sound: Exam Drill

Question 1

- (a) **B1** sound waves cao
- (a) Answer: **Sound waves**
- (b) **B1** light waves cao
- (b) Answer: **Light waves**
- (c) **B1** sound waves cao
- (c) Answer: **Sound waves**
- (d) **B1** light waves cao
- (d) Answer: **Light waves**

Question 2

- (a) **B1** True cao
- (a) Answer: **True**
- (b) **B1** False and because light can travel through a vacuum, cao
- (b) Answer: **False**

Question 3

- (a) **M1** substitute distance = 340 x 6.0
- (a) **M1** perform multiplication 340 x 6.0 = 2040
- (a) **A1** 2040 m cao
- (a) Answer: **2040 m**

Question 4

- (a) **B1** wavelength cao
- (a) Answer: **Wavelength**
- (b) **B1** frequency cao
- (b) Answer: **Frequency**

Question 5

- (a) **M1** identify wavelength = 1.44 / 6
- (a) **M1** perform division 1.44 / 6 = 0.24
- (a) **A1** 0.24 m cao
- (a) **B1** answer given with unit m
- (a) Answer: **0.24 m**

Question 6

- (a) **M1** calculate change = 452 - 440 = 12 Hz
- (a) **M1** substitute percentage = (12 / 440) x 100
- (a) **M1** perform calculation (12 / 440) x 100 = 2.727... percent
- (a) **A1** 2.7% to two significant figures cao
- (a) Answer: **2.7%**

Question 7

- (a) **M1** state angles are equal or the angle of incidence equals the angle of reflection
- (a) **A1** angles are equal cao
- (a) Answer: **equal to the angle of reflection**
- (b) **B1** diffuse reflection cao
- (b) Answer: **diffuse reflection**

Question 8

- (a) **M1** table entries correct or clear listing of pairs
- (a) **M1** describe that sound level decreases as distance increases
- (a) **A1** mention roughly 6 dB drop each time distance doubles or state decreasing trend cao
- (a) Answer: **Table: 0.5 m - 78 dB, 1.0 m - 72 dB, 2.0 m - 66 dB, 4.0 m - 60 dB. Trend: sound level decreases as distance increases; approximately 6 dB lower each time distance doubles.**
- (b) **M1** suggest controlling speaker volume or same speaker output
- (b) **A1** explain that controlling volume ensures distance is the only variable affecting sound level
- (b) Answer: **Control the speaker volume (keep it constant) so that only distance affects the measured sound level.**

Question 9

- (a) **B1** refraction cao
- (a) Answer: **Refraction**
- (b) **M1** state that light changes speed when entering a different material
- (b) **A1** so the change in speed causes the ray to change direction at the boundary (oe)
- (b) Answer: **Light slows down when it enters glass from air, causing the ray to change direction at the boundary.**

Question 10

- (a) **M1** substitute f = 15 / 0.025
- (a) **M1** perform division 15 / 0.025 = 600
- (a) **A1** 600 Hz cao
- (a) Answer: **600 Hz**
- (b) **B1** identify error and mitigation, e.g. timing error can be reduced by using electronic timing or counting more waves
- (b) Answer: **Timing reaction error; reduce it by using electronic timing or by counting more waves to increase measurement time.**

Question 11

- **Level 1** (1-2): Simple description: limited steps for experiment; mentions one or two variables; vague expected results.
- **Level 2** (3-4): Clear method with fair test: suggests controlling variables (mirror position, light source), suggests table of angle in and angle out and includes a basic explanation linking equal angles.
- **Level 3** (5-6): Detailed method and analysis: step by step fair test, multiple controlled variables, precise measurement technique, a suggestion for graphing angle of incidence vs angle of reflection, clear explanation that results should give a straight line with slope 1 showing angles equal and discussion of anomalies.
- **Indicative content:**
  - Method: place plane mirror on a sheet, draw normal line, shine narrow ray at set incidence angles (e.g. 10, 20, 30, 40, 50 degrees), measure reflected angle with protractor and record.
  - Control variables: same mirror, same light source, fixed distance from source to mirror, ensure protractor is aligned correctly.
  - Presentation: table of angle in and angle out; plot angle of reflection (y) against angle of incidence (x).
  - Expected results: angle of reflection equal to angle of incidence, points lie on y = x line; graph should be straight with gradient 1.
  - Analysis: anomalies may occur due to parallax error or wide beam; suggest repeating measurements and calculating mean.

Question 12

- (a) **M1** substitute f = 340 / 0.85
- (a) **M1** perform division 340 / 0.85 = 400
- (a) **A1** 400 Hz cao
- (a) **B1** give to three significant figures
- (a) Answer: **400 Hz**