3.4 Waves: Light and Sound: 30-minute Pack

Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 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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2 Tick whether the following statements are True or False and give a short reason for each tick.

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

- ☐ True
- ☐ False

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

- ☐ True
- ☐ False

3 Name the wave property described in each part.

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

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

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

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

5 Which type of wave is light? Choose from the options.

- ☐ A) Mechanical transverse
- ☐ B) Electromagnetic transverse
- ☐ C) Longitudinal pressure wave
- ☐ D) Matter wave

6 Describe an experiment to show that light travels in straight lines, including the main apparatus, the method and what you would observe.

(4)

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7 Which colours have longer wavelength: red or blue light? State the correct colour and one consequence in everyday life.

(2)

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8 Extended response (6 marks). A teacher asks a class to investigate how the pitch of a sound produced by a stretched string depends on the tension in the string. Describe a fair method the students could use, including: a list of the main apparatus, which variables to keep the same, how to change and measure tension, how to measure pitch, and how to decide whether increasing tension increases pitch. Include one safety consideration. Note: this is a design and evaluation answer, so give clear steps and reasons.

(6)

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Mark scheme · 3.4 Waves: Light and Sound: 30-minute Pack

Question 1

(a) substitute f = 340 / 0.85 **M1**

(a) perform division 340 / 0.85 = 400 **M1**

(a) 400 Hz cao **A1**

(a) give to three significant figures **B1**

(a) Answer: **400 Hz**

Question 2

(a) True cao **B1**

(a) Answer: **True**

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

(b) Answer: **False**

Question 3

(a) wavelength cao **B1**

(a) Answer: **Wavelength**

(b) frequency cao **B1**

(b) Answer: **Frequency**

Question 4

(a) table entries correct or clear listing of pairs **M1**

(a) describe that sound level decreases as distance increases **M1**

(a) mention roughly 6 dB drop each time distance doubles or state decreasing trend cao **A1**

(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) suggests any valid control variable, e.g. speaker volume or output, the same speaker, the same sound meter, the same room or background noise **M1**

(b) explains that controlling it ensures distance is the only variable affecting sound level **A1**

(b) Answer: **Control the speaker volume (keep it constant) so that only distance affects the measured sound level.**

Question 5

B cao **B1**

Answer: **B) Electromagnetic transverse**

Question 6

apparatus: ray box or torch, card with small hole, screen or white paper, several cards with holes in a line **M1**

method: align holes and shine light through holes so beam passes through all holes onto screen **M1**

observation: a single bright spot or straight line on the screen shows the light beam travelled straight **A1**

mention that if any card is moved out of line the spot disappears showing straight path dependence, oe **B1**

Answer: **Use a ray box or torch and several cards with aligned small holes, shine the light through all holes onto a screen; you will see a single bright spot or straight line on the screen, and if any card is moved out of line the spot disappears, showing light travels in straight lines.**

Question 7

red **B1**

consequence e.g. red light is scattered less by the atmosphere so sunsets appear red, oe **B1**

Answer: **Red light has a longer wavelength. One consequence is that red is scattered less in the atmosphere, which is why sunsets often look red.**

Question 8

Level 3 Detailed method: clear list of appropriate apparatus, specific controlled variables, correct way to change and measure tension, valid method to measure pitch and clear description of how data would show the effect; includes a safety point and justification. **5-6**

Level 2 Acceptable method: main apparatus and idea to change tension and measure pitch present, some controls stated, limited detail on measurement or analysis, safety mentioned. **3-4**

Level 1 Basic ideas: mentions that tension and pitch are related and gives one or two brief steps but lacks detail on measurement, controls or safety. **1-2**

Indicative content:

- Apparatus: string fixed across a wooden bridge or meter rule, set of known masses and pulley to change tension, clamp, frequency meter or mobile phone app to measure pitch, ruler, mass hanger, stopwatch not required.
- Variables to control: keep length of string constant, same string/material and thickness, same location and method of plucking, avoid changing temperature.
- Change and measure tension: add known masses to a hanger over a pulley so tension approximates to the weight of the masses (tension = mass x g). Record mass used; convert to tension in newtons if required.
- Measure pitch: use a frequency meter or phone app to record frequency for each tension, take several repeats and calculate mean frequency for each tension.
- Decide increase: plot frequency (pitch) against tension or look for consistent increase in mean frequency as tension increases; state trend and whether it is clear and repeatable.
- Safety: ensure masses are secured and fingers are clear when plucking to avoid getting hit by hanger; clamp apparatus to bench to avoid slipping.

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