

GCSE Combined Science: Trilogy

Worksheet: Properties of waves

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Properties of waves

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A water wave in a ripple tank has a frequency of 20 Hz and a wavelength of 0.015 m.

0 1 . 1

Calculate the speed of the wave.
Use the equation:
wave speed = frequency × wavelength

.....

.....

.....

.....

Wave speed = m/s

[2 marks]

.....

0 2

The paddle in a ripple tank takes 0.1 s to complete one vibration.

0 2 . 1

Calculate the frequency of the vibration of the paddle.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

.....

.....

.....

.....

Frequency = Hz

[2 marks]

0 3

0 3 . 1

Write down the equation that links wave speed, frequency and wavelength.

.....

.....

[1 mark]

0 3 . 2

A wave has a frequency of 4.0 Hz and a wavelength of 0.50 m.

Calculate its wave speed.

.....

.....

.....

.....

Wave speed = m/s

[2 marks]

0 3 . 3

Which row shows the correct unit for each quantity?

Tick (✓) **one** box.

frequency: Hz, wavelength: m, wave speed: m/s

☐

frequency: s, wavelength: m, wave speed: m/s

☐

frequency: Hz, wavelength: s, wave speed: m/s

☐

frequency: Hz, wavelength: m, wave speed: m

☐

[1 mark]

0 4

The prongs of a tuning fork vibrate with a frequency of 400 Hz.

0 4 . 1

Calculate the period of the vibration of the prongs.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

.....

.....

.....

.....

Period = s

[2 marks]

0 5

A student keeps the depth of water in a ripple tank constant, and changes the frequency of the vibrating paddle. Table 1 shows the wavelength produced at each frequency.

Table 1

Frequency in Hz	Wavelength in cm
2.0	15.0
3.0	10.0
5.0	6.0
6.0	5.0

0 5 . 1

Show that the speed of the waves is the same at every frequency in Table 1.

.....

.....

.....

.....

.....

.....

[3 marks]

0 5 . 2

Explain why the wavelength decreases as the frequency increases in Table 1.

.....

.....

.....

.....

[2 marks]

0 6

A student uses a ripple tank to investigate water waves. A lamp above the tank makes a pattern of bright lines on a sheet of white paper below the tank. The pattern moves across the paper as the waves travel.

0 6 . 1

The student measures the distance from the first bright line to the eleventh bright line. The distance is 27 cm.
Calculate the wavelength of the waves.

.....

.....

.....

.....

Wavelength = cm

[2 marks]

0 6 . 2

Explain why the student measured across several waves rather than measuring one wavelength.

.....

.....

[1 mark]

0 6 . 3

Write down the equation that links frequency, wavelength and wave speed.

.....

.....

[1 mark]

0 6 . 4

The student counts 32 waves passing a point on the paper in 20 s.
Calculate the speed of the waves in m/s.

.....

.....

.....

.....

.....

Speed = m/s

[4 marks]

0 6 . 5

Counting the waves is difficult because the pattern moves quickly.
Suggest **one** way the student could improve the measurement of the frequency.

.....

.....

[1 mark]

0 7

To measure the wavelength, a student uses a stroboscope to 'freeze' the wave pattern and measures the distance across five complete wavelengths with a ruler, repeating the measurement three times: 42 mm, 44 mm and 43 mm.

0 7 . 1

Explain why measuring across five wavelengths, rather than just one, gives a more precise value of the wavelength.

.....

.....

[1 mark]

0 7 . 2

Calculate the mean distance across five wavelengths, and hence the mean wavelength.

.....

.....

.....

.....

.....

Wavelength = mm

[3 marks]

0 7 . 3

Are these three repeat measurements repeatable? Justify your answer.

.....

.....

[1 mark]

0 8

A sound wave in air travels at a speed of 330 m/s and has a frequency of 660 Hz.

0 8 . 1

Calculate the wavelength of the wave.

.....

.....

.....

.....

.....

Wavelength = m

[3 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Properties of waves · 32 marks

Question 1 (2 marks)

01.1 [2 marks]

Answer: 0.3 m/s

- 20×0.015 (1)
 - 0.3 (m/s) (1)
-
-

Question 2 (2 marks)

02.1 [2 marks]

Answer: 10 Hz

- $1 \div 0.1$ (1)
 - 10 (Hz) (1)
-
-

Question 3 (4 marks)

03.1 [1 mark]

Answer: wave speed = frequency $\times$ wavelength

- wave speed = frequency $\times$ wavelength (1)

Notes: Allow $v = f\lambda$.

03.2 [2 marks]

Answer: 2.0 m/s

- 4.0×0.50 (1)
 - 2.0 (m/s) (1)
-

03.3 [1 mark]

Correct: frequency: Hz, wavelength: m, wave speed: m/s

Question 4 (2 marks)

04.1 [2 marks]

Answer: 0.0025 s

- $1 \div 400$ (1)
 - 0.0025 (s) (1)
-

Question 5 (5 marks)

05.1 [3 marks]

Answer: All four rows give a wave speed of 0.30 m/s.

- wave speed = frequency $\times$ wavelength calculated for at least two rows, e.g. $2.0 \times 0.150 = 0.30$ (m/s) and $6.0 \times 0.050 = 0.30$ (m/s) (1)
 - the same calculation for all four rows also gives 0.30 m/s (1)
 - so the wave speed does not change with frequency (it depends on the depth of the water, not the vibration frequency) (1)
-

05.2 [2 marks]

Answer: The speed stays constant, so by $v = f\lambda$, a higher frequency must go with a shorter wavelength.

- the speed of the waves stays the same (it depends on the water, not on the paddle's frequency) (1)
 - since wave speed = frequency $\times$ wavelength, if the frequency increases while the speed stays constant, the wavelength must decrease (1)
-

Question 6 (9 marks)

06.1 [2 marks]

Answer: 2.7 cm

- $27 \div 10$ (1)
- 2.7 (cm) (1)

Notes: There are 10 wavelengths between the first and eleventh lines. 2.45 ($27 \div 11$) scores 0.

06.2 [1 mark]

Answer: It reduces the uncertainty in the measured wavelength.

- one wavelength is small so its (percentage) uncertainty would be large / measuring many waves and dividing reduces the uncertainty in the wavelength (1)
-

06.3 [1 mark]

Answer: wave speed = frequency $\times$ wavelength

- wave speed = frequency $\times$ wavelength (1)

Notes: Allow $v = f \lambda$.

06.4 [4 marks]

Answer: 0.043 m/s (0.0432 m/s)

- frequency = $32 \div 20 = 1.6$ (Hz) (1)
- wavelength = 0.027 m (1)
- $v = 1.6 \times 0.027$ (1)
- 0.043 (m/s) (1)

Notes: Allow ECF from the wavelength. 4.32 (cm/s) scores 3 marks.

06.5 [1 mark]

Answer: Film the pattern and count the waves in slow motion (or use a stroboscope).

- use a stroboscope to 'freeze' the pattern / film the waves and play the video back in slow motion / count the waves for a longer time (1)
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Question 7 (5 marks)

07.1 [1 mark]

Answer: The uncertainty from the ruler's resolution is the same whether measuring one or five wavelengths, but it becomes a much smaller fraction of the (five times bigger) distance measured, so dividing by five gives a smaller percentage uncertainty.

- the (fixed) uncertainty from the ruler's resolution becomes a much smaller fraction of a bigger distance, so measuring across several wavelengths and dividing gives a smaller percentage uncertainty in the wavelength (1)

07.2 [3 marks]

Answer: 8.6 mm

- mean distance = $(42 + 44 + 43) \div 3 = 43$ (mm) (1)
- wavelength = $43 \div 5$ (1)
- = 8.6 (mm) (1)

07.3 [1 mark]

Answer: Yes — the three distances are close together (within 2 mm), obtained with the same equipment and method.

- yes — the three distances are close together (within 2 mm), using the same equipment and method (they are repeatable) (1)

Question 8 (3 marks)

08.1 [3 marks]

Answer: 0.5 m

- wavelength = wave speed $\div$ frequency (1)
 - $330 \div 660$ (1)
 - 0.5 (m) (1)
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