Your notes

GCSE Physics: revision notes

Wave speed, frequency and wavelength

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The wave equation

- **Wave speed** is the speed at which energy is transferred (or the wave moves) through the medium.
- $v = f \lambda$: **wave speed** (m/s) = frequency (Hz) × wavelength (m).
- Rearranging: $f = v \div \lambda$ and $\lambda = v \div f$.
- All electromagnetic waves travel at 3×10^8 m/s through a vacuum.

Measuring the speed of sound

- Two people stand a measured distance apart, for example 400 m. One makes a loud sound with a visible action (clapping cymbals); the other starts a stopwatch on seeing it and stops it on hearing it.
- Speed = distance ÷ time. The speed of sound in air is about 330 m/s.
- An **echo** method can also be used: the sound travels to a wall and back, so the distance is doubled.

Required practical: ripple tank

- Use a **ripple tank** with a vibrating bar to make waves, and a lamp above to show the waves on a screen below.
- Measure the wavelength by measuring across several waves (say 10) and dividing by the number of waves. Use a strobe or photograph to freeze the waves.
- Count the waves passing a point in 10 seconds to find the frequency, then calculate the speed with $v = f \lambda$.

Required practical: waves on a string

- Attach a string to a vibration generator and pass it over a pulley with a hanging mass to keep it tight.
- Adjust the frequency until a clear standing wave forms. Measure the length of several half-wavelengths to find the wavelength.
- Read the frequency from the **signal generator** and calculate the speed with v = f λ.

Worked examples

A wave has a frequency of 50 Hz and a wavelength of 0.4 m. Find its speed.

Use the wave equation. **v = f × λ**

Put the numbers in. **50 × 0.4**

Answer: 20 m/s

A sound wave has a wavelength of 3 cm and a frequency of 10 000 Hz. Find its speed.

Change the wavelength to metres first. **3 cm = 0.03 m**

Use v = f × λ. **10 000 × 0.03**

Answer: 300 m/s

Key terms

Wave speed	The speed at which a wave transfers energy through a medium.
Wave equation	v = f λ.
Echo	A reflected sound wave.
Ripple tank	A shallow tank of water used to study water waves.
Signal generator	A device that sets the frequency of a vibration generator or loudspeaker.
Stroboscope	A flashing light that makes moving waves appear to stand still.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is the wave equation?
2. A wave has a frequency of 50 Hz and a wavelength of 0.2 m. What is its speed?
3. A sound wave travels at 340 m/s with a frequency of 170 Hz. What is its wavelength?
4. How fast do electromagnetic waves travel in a vacuum?

Your notes

5. What is the approximate speed of sound in air?
6. Why do you measure across several waves in the ripple tank?
7. A radio wave has a wavelength of 3 m. What is its frequency?
8. In the echo method for measuring the speed of sound, why is the distance doubled?

Answers

1. Wave speed = frequency × wavelength
2. 10 m/s
3. 2 m
4. 3×10^8 m/s
5. 330 m/s
6. To get a more accurate wavelength
7. 1×10^8 Hz
8. The sound travels to the wall and back

What to do next

Practise 10 questions on this topic

Try 5 exam questions, with mark schemes

Read the lesson, one step at a time

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