

Wavelength, frequency and how waves behave

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These twenty problems practise the wave equation $v = f \lambda$, the link between period and frequency, and the behaviour of waves at barriers, gaps and boundaries. You will read graphs, work from data tables and explain phenomena.

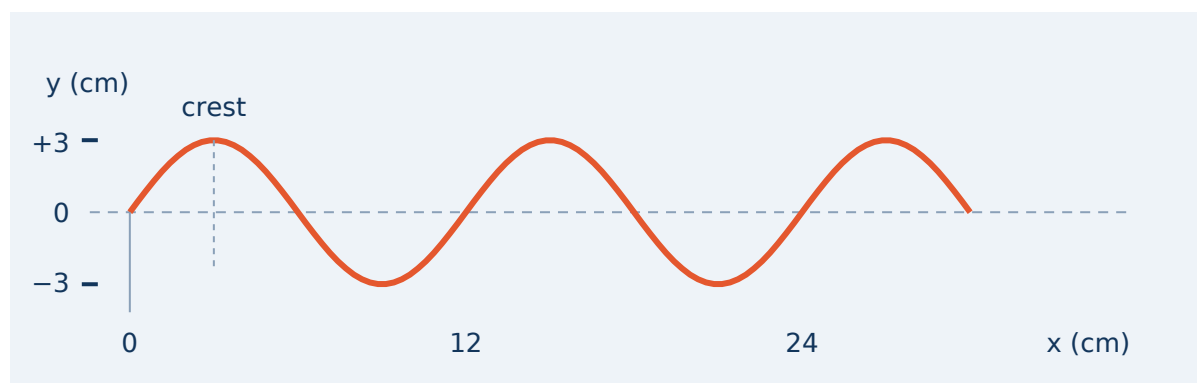
They suit GCSE, IGCSE, O Level and Class 9-10 students. Convert units such as cm to m, and MHz or GHz to hertz, before you calculate.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS4-1, GCSE P6

Problem 1 Classify the waves (easy)

Say whether each wave is transverse or longitudinal: (a) ripples on a pond, (b) a push-pull pulse on a slinky, (c) a shaken rope, (d) light.

Problem 2 Reading a wave graph (easy)



Displacement y against distance x along a rope.

Use the graph.

1. State the amplitude.
2. State the wavelength.

Problem 3 Frequency and period (easy)

Calculate (a) the frequency of a wave with period 0.050 s, and (b) the period of a wave with frequency 4.0 Hz.

Problem 4 First wave speed (easy)

A wave has a frequency of 50 Hz and a wavelength of 0.30 m. Calculate its speed.

Problem 5 Law of reflection (easy)

State the law of reflection. A wave hits a barrier with an angle of incidence of 35° . Give the angle of reflection and the angle between the incident and reflected rays.

Problem 6 Waves on a rope (medium)

A wave on a rope has a wavelength of 1.2 m and travels at 3.0 m/s. Calculate its frequency.

Problem 7 Wi-Fi wavelength (medium)

Diego in Texas uses a router that transmits at 2.4 GHz. Radio waves travel at 3.0×10^8 m/s. Calculate the wavelength in centimetres.

Problem 8 Radio station (medium)

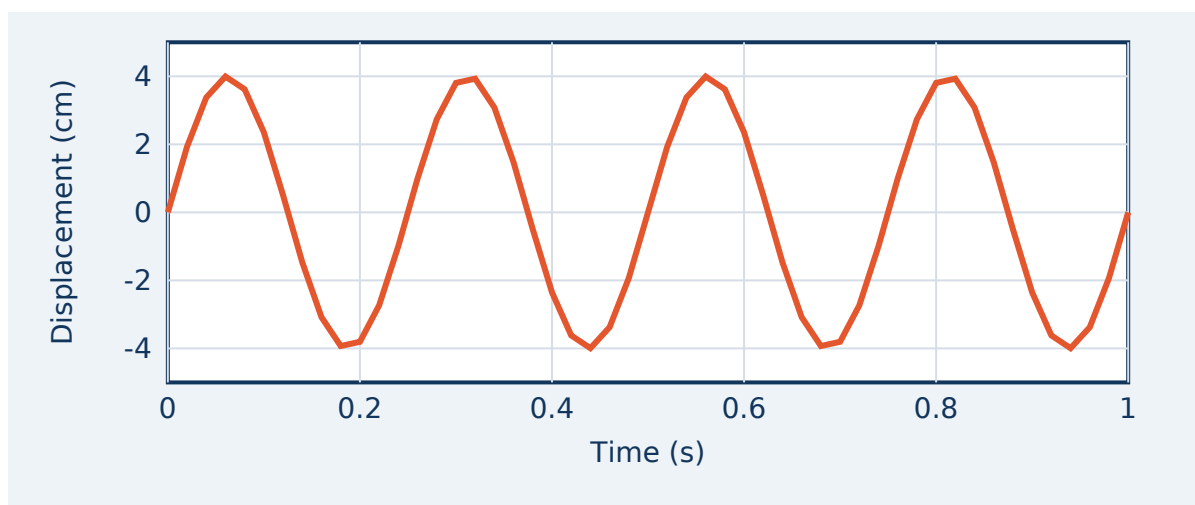
A radio station broadcasts at 96.3 MHz. Calculate the wavelength of its waves in metres. Use $v = 3.0 \times 10^8$ m/s.

Problem 9 A buoy on Lake Victoria (medium)

Wanjiru watches a buoy as 20 waves pass it in 50 s. The wavelength is 6.0 m.

1. Calculate the frequency.
2. Calculate the period.
3. Calculate the wave speed.

Problem 10 Displacement-time graph (medium)



Displacement of one particle of the medium over time.

The graph shows the motion of one particle as waves pass.

1. State the amplitude.
2. Find the period and the frequency.
3. The wavelength is 0.30 m. Calculate the wave speed.

Problem 11 Into shallow water (medium)

In a ripple tank the waves have frequency 5.0 Hz. In the deep part the wavelength is 3.0 cm; in the shallow part it is 2.0 cm.

1. Calculate the speed in each region.
2. State what happens to the frequency.

Problem 12 Which gap spreads the waves? (medium)

Ripples of wavelength 2 cm meet gaps of width 1 cm, 5 cm and 20 cm. Which gap gives the most diffraction? Explain.

Problem 13 Seismic waves (medium)

An earthquake epicentre is 420 km from a station. P-waves (longitudinal) travel at 6.0 km/s and S-waves (transverse) at 3.5 km/s. Calculate how much later the S-waves arrive.

Problem 14 Spot the error (medium)

A student says: when I double the frequency of waves on a rope, the waves travel twice as fast. Explain what is wrong and what really happens.

Problem 15 Stadium wave (medium)

A wave of standing spectators goes round a stadium of circumference 400 m in 25 s. Its frequency is 0.80 Hz at any seat. Calculate the wave speed and the wavelength.

Problem 16 Deep and shallow (hard)

Water waves of frequency 6.0 Hz travel at 0.24 m/s in a deep part of a tank and enter a shallow part where the wavelength is 3.0 cm.

1. Calculate the wavelength in the deep part.
2. Calculate the speed in the shallow part.
3. Calculate the ratio of the shallow speed to the deep speed.

Problem 17 A tsunami (hard)

In the deep ocean a tsunami travels at 220 m/s with a wavelength of 200 km.

1. Calculate its frequency and period in minutes.
2. Near the coast the speed falls to 22 m/s. Calculate the new wavelength and explain what stays the same.

Problem 18 Two barriers (hard)



Water waves reflecting from two barriers at 90°.

A wave hits barrier 1 at 40° to its surface, then reflects onto barrier 2 that meets it at 90°.

1. Calculate the angle of incidence at barrier 1.
2. Calculate the angle between the wave path and barrier 2, and the angle of incidence there.
3. Describe the direction of the final wave compared with the incoming wave.

Problem 19 Rope data (hard)

Students measure the wavelength of waves on a stretched rope at different frequencies.

f (Hz)	2.0	3.0	4.0	5.0	6.0
λ (m)	1.50	1.00	0.75	0.60	0.50

1. Calculate the speed for each pair.
2. State the relationship between λ and f and explain it.
3. Predict the wavelength at 7.5 Hz.

Problem 20 Radio and hills (hard)

A radio transmitter sends waves of wavelength 1500 m and a mobile network uses waves of wavelength 0.15 m. A hill about 200 m wide lies between a town and the transmitters. Explain which signal reaches the town more easily.