Covering teacher guide

Transverse and longitudinal wave properties

Start here / subject briefing

Before this lesson: Consolidation after wave types, simple displacement graphs and frequency/period have been taught. The drawing task uses models; no demonstration is needed.

Classify a wave by comparing particle oscillation with wave travel: perpendicular is transverse; parallel is longitudinal. Waves transfer energy while particles in these models oscillate locally. Amplitude is measured from equilibrium. A distance snapshot gives wavelength; a time trace gives period. Frequency counts complete cycles per second.

Words and symbols you will need

Term	Plain-English meaning
Oscillation / equilibrium	Back-and-forth motion about the undisturbed position.
Transverse / longitudinal	Oscillations perpendicular / parallel to wave travel.
Compression / rarefaction	Closer / wider particle spacing in a longitudinal wave.
Amplitude / wavelength	Maximum displacement from equilibrium / spacing between adjacent matching points.
Period T / frequency f	Seconds per complete cycle / cycles per second in Hz. f=1/T.

Help pupils choose a method

1. Read what each arrow and axis represents; compare directions rather than the shape alone.

2. Use equilibrium for amplitude and adjacent matching points for wavelength or period. Count gaps between crests.

3. Frequency = complete cycles / seconds, or 1/period. Explain local particle motion separately from the travelling disturbance.

Use the supplied model - pupil page 2

Use pupil page 2: the vertical rope motion is perpendicular to rightward travel. Four cycles in 2 s gives two cycles each second; each cycle takes half a second.

Transverse: the oscillation is perpendicular to wave travel. Frequency = 4 / 2.0 = 2.0 Hz. Period = 1 / 2.0 = 0.50 s per complete oscillation. The marked point is not carried right with the disturbance.

If pupils are still stuck

Use the matching Say/Ask/Expect coaching and named retry within its replacement time. If still insecure, help label the two directions, axis units or equilibrium reference, then record the exact remaining error for the usual teacher. Do not improvise an experiment.

Turn to teacher page 2 for the timed run sheet. Keep this guide separate from the pupil booklet.

Run the lesson from this page

Transverse and longitudinal wave properties

Print the complete 8-page pupil booklet, one per pupil, stapled in order. Double-sided printing is fine.

Read teacher page 1, then use the timed run sheet on page 2. Keep the 10-page teacher guide separate from pupil copies.

Pupils need pens, a ruler and a calculator. Reading, data and figures are supplied. No login, pupil devices or practical apparatus are required.

Min	Pupil page / Q	Read aloud / check	Next action and answer key
0-5	1 / 1-3	Start from memory; check the three answers at 5 minutes.	If insecure use Try again A in the first 2 reading minutes. Answers: teacher page 3. Coaching: page 7.
5-15	2 / reading	Read the two direction rules, quantity table and model.	Check A if used; then continue reading.
15-20	3 / 4	Choose a letter and justify amplitude and wavelength. Stop at check 2.	If insecure B replaces questions 5-6. Answers: teacher page 3. Coaching: page 8.
20-30	3-4 / 5-8	Apply wave directions, read Figure 1 and explain marker motion.	If B was used leave 5-6 blank. Require equilibrium reference and crest intervals. Answers: teacher page 4.
30-33	5 / 9	Complete question 9 independently and pause.	If insecure C replaces questions 10-11. Answers: teacher page 4. Coaching: page 9.
33-45	5-7 / 10-15	Use the time trace, motion descriptions and drawing boxes.	If C was used leave 10-11 blank; complete 12-15. Allow about 4 minutes for sketches. Answers: teacher page 5.
45-55	8 / 16	Correct practice and explain one correction in a different colour.	Share only practice answers. Check sketch directions and labels. Answers: teacher page 5.
55-60	8 / 17	Cover earlier pages. Complete question 17 independently.	Collect all booklets and check afterwards. D is next lesson only. Answers: teacher page 6. Coaching: page 10.

Estimated 60 minutes. Practice: 10 minutes, a 3-minute check and 12 minutes including about 4 minutes for sketches. A uses reading time; B replaces 5-6; C replaces 10-11; D is next lesson only. Timings are not classroom-trialled.

Entry and hinge - pupil pages 1 and 3

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

1. (pupil p1) Perpendicular: particle motion is at right angles to wave travel.

2. (pupil p1) Amplitude = 8 / 2 = 4 mm.

3. (pupil p1) Period, T = 2.0 s. A time-axis interval is not wavelength.

4. (pupil p3) B: amplitude is 3 cm from equilibrium; wavelength = 0.50 - 0.10 = 0.40 m. The 6 cm full height is not amplitude; 0.50 m is a coordinate, not crest spacing.

Try again A - pupil page 1

Only if directed. Use the first 2 reading minutes, then continue on page 2.

(a) Perpendicular. (b) 5 mm. (c) Period = 3 s.

Try again B - pupil page 3

Only if directed. Complete this instead of questions 5-6; then answer questions 7-8.

Amplitude = 2.5 cm; wavelength = 0.80 - 0.20 = 0.60 m.

First practice and mid-check - pupil pages 3-5

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

5. (pupil p3) Transverse. The marker oscillates perpendicular to the direction of wave travel. Real water-particle motion is more complex than this GCSE model.

6. (pupil p4) 0.40 m, from the undisturbed position to a crest. The full peak-to-trough height is 0.80 m, not the amplitude.

7. (pupil p4) Four crests enclose three wavelength intervals. Wavelength = 72 / 3 = 24 m. Adjacent crests at 0 and 24 m also establish 24 m.

8. (pupil p4) The wave transfers energy across the water. Water/marker oscillates locally rather than travelling along with each crest; no net transport of the medium in this model. Do not say particles never move.

9. (pupil p5) Period = 0.70 - 0.20 = 0.50 s. Frequency = 1 / 0.50 = 2.0 Hz. No: the axis is time in seconds, so the interval is period; wavelength needs a distance axis.

Try again C - pupil page 5

Only if directed. Complete this instead of questions 10-11; then continue with questions 12-15.

T = 3.0 - 1.0 = 2.0 s; f = 1 / 2.0 = 0.50 Hz. The time axis gives seconds per cycle, not a distance.

Later practice, sketches and review

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

10. (pupil p5) 4.0 s, e.g. crest at 0 s to crest at 4 s, or 4-8 s or 8-12 s. Crest to trough is only half a period.

11. (pupil p5) f = 1 / T = 1 / 4.0 = 0.25 Hz. Also accept 3 complete oscillations / 12 s.

12. (pupil p6) 6.0 m/s describes the travelling disturbance horizontally. The moored buoy oscillates vertically about its undisturbed position; it does not travel horizontally with each crest at that speed.

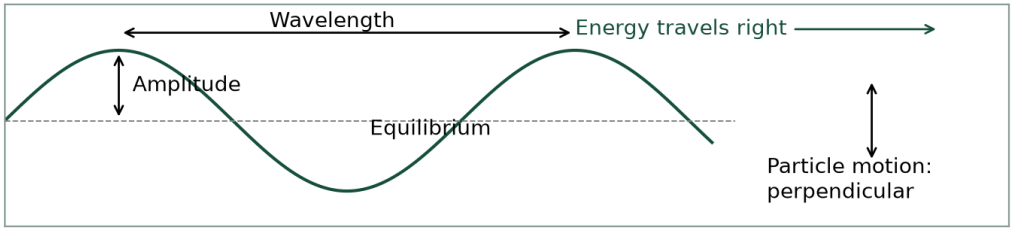
13. (pupil p6) Transverse: the moving string points oscillate perpendicular to the wave-travel direction. Do not require an explanation of stationary-wave formation or claim every point moves.

14. (pupil p6) Particles oscillate back and forth parallel to wave travel. They are closer together in compressions and further apart in rarefactions. They do not travel steadily from source to listener.

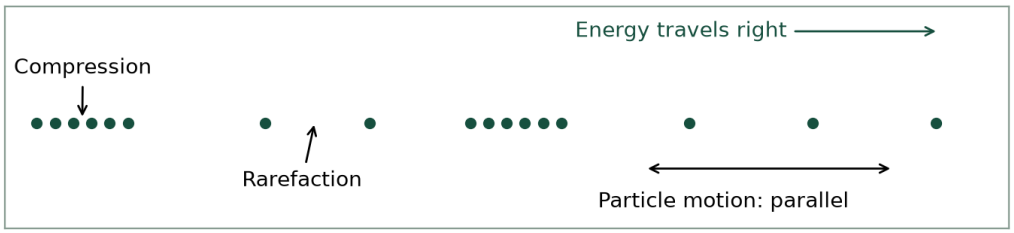
15. (pupil p7) (a) A transverse profile with equilibrium midway between crest/trough; amplitude from equilibrium to crest/trough and wavelength between adjacent matching points. Particle-motion arrow vertical, perpendicular to rightward wave travel. (b) Alternating dense and sparse groups of particles; compression in a dense group, rarefaction in a sparse group. Particle-motion arrow horizontal, parallel to rightward wave travel. Accept a clear coil model. The longitudinal model must not imply that particles follow a transverse sine path.

16. (pupil p8) Accept a corrected answer with the reason for its original error. All-correct route: the horizontal quantity/unit determines the meaning: distance between matching points gives wavelength; time between successive matching phases gives period.

Transverse model



Longitudinal model



One valid model for question 15. Accept clear equivalent sketches; particle-motion directions and labels matter.

Independent exit and next-lesson follow-up

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

17. (pupil p8) (a) f = 14 / 7.0 = 2.0 Hz; T = 1 / 2.0 = 0.50 s. (b) 4 mm. (c) Longitudinal: oscillation parallel to travel. Particles oscillate locally rather than travelling steadily right with the pattern; energy/disturbance travels.

Try again D - next lesson - pupil page 8

Leave this today. Your usual teacher may direct it next lesson.

f = 9 / 3 = 3 Hz; T = 1/3 s, approximately 0.33 s; amplitude 6 mm. Transverse, because the directions are perpendicular. Particles oscillate locally; they do not travel upward with the wave.

Collect and follow up

Collect every named booklet including sketches. Use question 17 to record quantities, wave classification and particle-versus-pattern reasoning. Report exact remaining errors and who needs Try again D.

Source provenance - for the usual teacher

Pupil question	Original worksheet part / page
5	WS-11 Q1(a) / source p1
6	WS-11 Q2(a) / source p2
7	WS-11 Q2(b) / source p2
8	WS-11 Q2(e) / source p3
10	WS-11 Q3(a) / source p3
11	WS-11 Q3(b) / source p3
12	WS-11 Q3(d) / source p4
13	WS-11 Q5(a) / source p7
14	WS-11 Q6(a) / source p8

Selected practice is reformatted from the maintained PhysicsUK worksheet. Required context is included; unassigned parts are omitted.

Source worksheet | Maintained solutions | Revision notes

The source worksheet is shared with the wave-speed lesson but this selection emphasises properties and transfer. Q3(d) has the omitted Q3(c) result supplied as a given. The small labelled-sketch task and diagnostic/retry data are original cover-lesson content.

Check 1: Entry

Question 1, Question 2, Question 3

Look for: Q1 perpendicular; Q2 amplitude 4 mm; Q3 period 2.0 s.

If secure: Continue to page 2 reading and model.

If: Q1 says parallel or treats a rope point as travelling right with the pattern.

Likely issue: Particle motion and wave travel have been confused.

Say: Compare two separate directions: the disturbance travels right; the point moves up/down. These directions are at right angles.

Ask: In question 1, does the rope point move along the same line as the travelling disturbance?

Expect: No. Its motion is vertical and wave travel horizontal: perpendicular.

Next: Use the matching rule on page 2; direct Try again A on page 1 in the first 2 reading minutes.

Pupil page 2, directions/quantity definitions and axis rule.

If: Q2 gives 8 mm, or Q3 calls 2.0 s a wavelength.

Likely issue: The displacement reference or horizontal-axis quantity is insecure.

Say: Amplitude runs from equilibrium to one extreme, half the symmetric full height. A time interval between matching phases is period.

Ask: For questions 2-3, what is half of 8 mm, and what does a spacing measured in seconds represent?

Expect: 4 mm amplitude; period of 2.0 s.

Next: Use the matching rule on page 2; direct Try again A on page 1 in the first 2 reading minutes.

Pupil page 2, directions/quantity definitions and axis rule.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 2: Hinge

Question 4

Look for: B with amplitude 3 cm from equilibrium and wavelength 0.50-0.10=0.40 m.

If secure: Start questions 5-8. Require a reason and matching-point difference.

If: A uses the full 6 cm height as amplitude.

Likely issue: Amplitude has been measured from trough to crest.

Say: Equilibrium is the reference for amplitude. Three centimetres above it is one maximum displacement; the full height includes two amplitudes.

Ask: In question 4, how far is the crest from equilibrium, rather than from the trough?

Expect: 3 cm, so B has the correct amplitude.

Next: Use page 2 definitions and complete Try again B on page 3 instead of questions 5-6.

Pupil page 2, directions/quantity definitions and axis rule.

If: C gives the final 0.50 m coordinate as wavelength.

Likely issue: A position coordinate has been used instead of spacing.

Say: Wavelength is the distance between the two crests, so subtract their positions. A nonzero starting coordinate matters.

Ask: For question 4, what is 0.50 minus 0.10?

Expect: 0.40 m, the separation of adjacent crests.

Next: Use page 2 definitions and complete Try again B on page 3 instead of questions 5-6.

Pupil page 2, directions/quantity definitions and axis rule.

If: D uses seconds, or B is selected without reasons.

Likely issue: The axis unit is insecure or the letter may be a guess.

Say: A distance snapshot gives spatial spacing in metres. Confirm the equilibrium-to-crest height and the difference of crest positions.

Ask: In question 4, which units belong to the two plotted directions, and how did you obtain your two values?

Expect: Vertical amplitude 3 cm; horizontal wavelength 0.50-0.10=0.40 m. The horizontal axis is not time.

Next: Use page 2 definitions and complete Try again B on page 3 instead of questions 5-6.

Pupil page 2, directions/quantity definitions and axis rule.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 3: Mid Practice

Question 9

Look for: Q9 period 0.50 s; frequency 2.0 Hz; time spacing is not wavelength.

If secure: Continue questions 10-15, including the sketches.

If: Calls 0.50 s wavelength or uses 0.70 s as the period.

Likely issue: The axis quantity or subtraction of successive phases is insecure.

Say: A time trace measures one point repeatedly. Take the difference between successive matching phases; the result is time per cycle.

Ask: In question 9, what is 0.70-0.20 and what unit is on the horizontal axis?

Expect: 0.50 s, a period.

Next: Use page 2, the axis rule and f=1/T. Complete Try again C on page 5 instead of questions 10-11.

Pupil page 2, directions/quantity definitions and axis rule.

If: Uses 0.50 Hz as frequency or multiplies rather than taking the reciprocal.

Likely issue: Period and frequency have been equated.

Say: Period is seconds per cycle; frequency is cycles per second. Take 1 divided by the period.

Ask: How many 0.50 s cycles fit in one second in question 9?

Expect: Two cycles: 2.0 Hz.

Next: Use page 2, the axis rule and f=1/T. Complete Try again C on page 5 instead of questions 10-11.

Pupil page 2, directions/quantity definitions and axis rule.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 4: Exit

Question 17

Look for: Q17 f=2.0 Hz, T=0.50 s, amplitude 4 mm; longitudinal because oscillations are parallel, with no steady rightward particle transport.

If secure: Record independently secure quantities, directions and energy-transfer reasoning.

If: Incorrect frequency/period or doubles the 4 mm amplitude.

Likely issue: Cycle rate, reciprocal or the displacement reference remains insecure.

Say: Count complete cycles per second, then take the reciprocal for period. The stated maximum displacement already is amplitude.

Ask: In question 17, what are 14/7 and its reciprocal? Does the 4 mm need doubling?

Expect: 2.0 Hz and 0.50 s. Amplitude is 4 mm without doubling.

Next: Next lesson revisit page 2, then complete Try again D independently on page 8.

Pupil page 2, directions/quantity definitions and axis rule.

If: Calls it transverse or says particles travel steadily right with the wave.

Likely issue: The two directions or local oscillation versus transfer remains insecure.

Say: Parallel back-and-forth motion identifies longitudinal waves. Energy travels with the disturbance while material particles oscillate locally.

Ask: In question 17, do particle oscillations lie along or across the rightward travel direction?

Expect: Along it: parallel, so longitudinal. Particles do not travel steadily with the pattern.

Next: Next lesson revisit page 2, then complete Try again D independently on page 8.

Pupil page 2, directions/quantity definitions and axis rule.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Specification and review

AQA 8463: 4.6.1.1, 4.6.1.2 | AQA 8464: 6.6.1.1, 6.6.1.2. Both courses and tiers: wave/particle directions, local oscillation and energy transfer, amplitude/wavelength/period/frequency and labelled models. Stationary-wave formation, practical methods and sound boundaries are excluded.

PhysicsUK original cover lesson. Reviewed 2026-10-31. Timings estimated.