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Smarter practice. Stronger understanding

WORKSHEETS
ATTEMPT | CHECK | CORRECT | IMPROVE

AQA AS Progressive Waves, Phase and Polarisation worksheet

35–40 minutes independent practice + 15–20 minutes review | 40 marks

Specification points covered

• 3.3.1.1(a) Amplitude, frequency, wavelength, speed and phase. • 3.3.1.1(b) Use c = fλ. • 3.3.1.1(c) Use f = 1/T. • 3.3.1.1(d) Phase in radians, degrees or fractions of a cycle. • 3.3.1.2(a) Longitudinal and transverse waves. • 3.3.1.2(b) Sound, electromagnetic and string-wave examples.	• 3.3.1.2(c) Displacement or field oscillation and energy propagation. • 3.3.1.2(d) Common electromagnetic-wave speed in vacuum. • 3.3.1.2(e) Polarisation as evidence for transverse waves. • 3.3.1.2(f) Polaroid filters and aerial alignment. • 3.3.1.2(g) Malus' law is not required.

Whale-acoustics tag and satellite buoy

Marine researchers track a whale with sound in seawater while a surface buoy sends the data to a satellite by radio.
Use precise wave language: quantities increase or decrease, particles oscillate, and energy propagates.

1. The acoustic pulse

1. A whale tag emits an acoustic pulse through seawater. Explain why the sound is longitudinal and distinguish the direction of particle displacement from the direction of energy transfer. [4 marks]

2. The tag emits at 30.0 kHz. The speed of sound in seawater is 1500 m s^{-1}. Calculate the period and wavelength of the wave. [3 marks]

2. Phase along the wave

3. Two hydrophones lie on the direction of travel and are 12.5 mm apart. Calculate their phase difference in degrees and radians for the wave in Question 2. **[3 marks]**

4. At one instant, hydrophone A is at maximum positive displacement. State the displacement and phase of a point half a wavelength farther along the same wave. **[2 marks]**

5. A pulse takes 7.50 s to travel from the tagged whale to a hydrophone. Calculate the distance to the whale. Explain why the water particles do not travel this distance with the pulse. **[3 marks]**

3. Radio link

6. The surface buoy sends data to a satellite at 800 MHz. Calculate the wavelength in vacuum and state what happens to all electromagnetic-wave speeds in vacuum when frequency changes. [3 marks]

7. Two radio paths to the receiver differ in length by 0.125 m. Calculate the phase difference caused by this path difference for the wavelength in Question 6. [3 marks]

8. The received radio signal has a larger amplitude after the transmitter power is increased. State what amplitude describes for a progressive wave and explain what is being transported to the satellite. [2 marks]

4. Polarisation in practice

9. The satellite signal can be received through one orientation of a polarising filter but not through the perpendicular orientation. Explain how this observation supports the statement that electromagnetic waves are transverse. [3 marks]

10. A storm twists the buoy's transmitting aerial through 90° while the satellite aerial remains fixed. Predict and explain the effect on the received signal, and state one corrective action. [3 marks]

11. Reflected glare entering an onboard camera is unpolarised before reflection and strongly plane-polarised afterwards. Describe unpolarised light and explain how rotating a Polaroid filter can reduce the glare. [3 marks]

5. Connecting the system

12. The whale changes its call from 15 kHz to 30 kHz in the same water. Compare the wavelength, period and wave speed of the two calls. [3 marks]

13. Recommend how the team should use the hydrophones and buoy aerial to identify the whale call and maintain a reliable satellite link. Use frequency, wavelength, phase, wave type and polarisation precisely. [5 marks]

Review and improve

□ I distinguish particle displacement from energy propagation.
□ I convert path difference into phase difference.
□ I explain polarisation using transverse oscillations and aerial alignment.