

Interference, resonance and the Doppler shift

AP Physics 2 (algebra-based) · Test answers (mark scheme)

Marks are shown for each step. Method marks are given for the right relationship even if the arithmetic slips, but every final answer needs its unit.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 14

Question 1 Double slit calculation (3 marks)

a. $\Delta y = \lambda L / d = 520 \times 10^{-9} \times 1.80 / 1.5 \times 10^{-4} = \mathbf{6.24 \text{ mm}}$.

b. $y_3 = 3 \times 6.24 = \mathbf{18.7 \text{ mm}}$.

Marking: formula (1), correct value with unit (1); order multiplied (1).

Question 2 Changing the set-up (2 marks)

a. Halving d doubles the spacing and halving L halves it, so the new spacing is **equal to the old one**.

b. $\Delta y = \lambda L / d$: factor 2 from d and factor $\frac{1}{2}$ from L cancel.

Marking: correct prediction (1); reason using the formula (1).

Question 3 Oil film (3 marks)

a. The air-oil reflection flips the phase; the oil-water reflection does not.

b. $2nt = \lambda/2$, so $t = \lambda / 4n = 580 / (4 \times 1.45) = \mathbf{100 \text{ nm}}$.

Marking: correct interface (1); condition (1); answer (1).

Question 4 Standing wave on a string (2 marks)

a. Three half wavelengths fit in 1.2 m: $\lambda = 2L/3 = \mathbf{0.80 \text{ m}}$.

b. $f = v / \lambda = 48 / 0.80 = \mathbf{60 \text{ Hz}}$.

Marking: one mark each.

Question 5 Closed pipe (3 marks)

a. $f_1 = v / 4L = 340 / 3.4 = \mathbf{100 \text{ Hz}}$.

b. Next is the third harmonic: **300 Hz**.

c. A closed end is a node and an open end is an antinode, so only odd multiples of a quarter wavelength fit; 200 Hz would need an even number.

Marking: one mark each part.

Question 6 Moving source (3 marks)

- a. $f' = 800 \times 340 / 320 = \mathbf{850 \text{ Hz}}$.
- b. $f' = 800 \times 340 / 360 = \mathbf{756 \text{ Hz}}$.
- c. The source moves between emissions, so wavefronts ahead are closer together and wavefronts behind are further apart.

Marking: one mark each part.

Question 7 White-light fringes (2 marks)

- a. The central fringe is **white**, because all wavelengths have zero path difference there.
- b. Fringe positions depend on wavelength, so each colour has its own fringe positions and the colours separate at higher orders.

Marking: one mark each part.

Question 8 Beats (2 marks)

- a. $f_{\text{beat}} = 516 - 512 = \mathbf{4 \text{ Hz}}$.
- b. Time between loud sounds = $1 / 4 = \mathbf{0.25 \text{ s}}$.

Marking: one mark each part.