**Question 25** (Answer: **B**)

- Count the wavelengths between P and Q: they are $1\frac{1}{4}$ wavelengths apart.
- Each whole wavelength is 360°, so $1.25 \times 360 = 450°$.
- A phase difference above 360° is perfectly normal for points more than one wavelength apart.

**Question 26** (Answer: **D**)

- Read the amplitudes off the graph: X is 0.40 cm and Y is 0.75 cm.
- Intensity is proportional to the *square* of the amplitude.
- $(0.75/0.40)^2 = 1.875^2 = 3.5$, so wave Y has intensity $3.5I$; C is the ratio without squaring.

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**Question 24** (Answer: **D**)

- The wave moves to the right, so P next takes on the displacement of the string just to its left – which is below the axis.
- P is therefore moving downwards at $t = 0$, and since it sits at zero displacement it is at maximum speed.
- So the velocity starts at its largest *negative* value; C has the right shape but starts at zero.

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**Question 26** (Answer: **A**)

- A phase difference of 270° is three quarters of a wavelength along the string.
- One wavelength is the distance between successive crests, so measure $\frac{3}{4}$ of that from X.
- For comparison, a whole wavelength apart is in phase and half a wavelength apart is antiphase.

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**Question 24** (Answer: **D**)

- In a transverse wave a particle moves fastest as it passes through zero displacement.
- At a crest or a trough it is momentarily at rest before reversing.
- So the fastest particle is the one sitting on the axis, not the one at the largest displacement.

**Question 26** (Answer: **B**)

- Measure one whole cycle crest to crest: it spans 3.5 divisions.
- With the time-base at 300 $\mu$s per division, $T = 3.5 \times 300 = 1050$ $\mu$s.
- $f = 1/(1.05 \times 10^{-3}) = 950$ Hz; the y-gain plays no part in a frequency.

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**Question 20** (Answer: **B**)

- Amplitude is measured from the centre line to a peak: 3 divisions at 1 V per division is 3 V.
- One complete cycle spans 2 divisions, so $T = 2 \times 2.0 = 4.0$ ms.
- $f = 1/(4.0 \times 10^{-3}) = 250$ Hz; C and D take the peak-to-peak height as the amplitude.

| | |
|---|---|
| 5(a) | wavelength:<br>• wavelength = distance between successive / adjacent in phase points / wavefronts / crests / troughs<br>• $\lambda = d$ / (number of) oscillations<br><br>frequency:<br>• frequency = (number of) oscillations / cycles crests / troughs / wavefronts (passing a point) per unit time<br>• $f$ = (number of) oscillations / $t$<br><br>One correct point from **either** list |
| | One correct point from **both** lists **and**<br>speed = distance / time **and**<br>one of:<br>• wavelength × frequency (= distance per unit time) = speed<br>• [(number of) oscillations / $t$ ] × [$d$ / (number of) oscillations] = $f\lambda$<br>• $v (= d / t) = \lambda / (1/f) = f\lambda$ or<br>$v (= d / t) = \lambda / T = f\lambda$ |
| 5(b)(i) | $T = 4 \times 10^{-3}$<br><br>$f = 1 / T = 1 / 0.004$ |
| | $f = 250$ Hz |
| 5(b)(ii) | $f_o = f_s\, v / (v - v_s)$<br><br>$250 = 236 \times v / (v - 20)$<br><br>$v = (250 \times 20) / (250 - 236)$ |
| | $= 360$ m s$^{-1}$ |



| | |
|---|---|
| 3(a) | 10.0 cm |
| 3(b)(i) | $v = f\lambda$<br>$= 16 \times 0.40$ |
| | $= 6.4$ m s$^{-1}$ |
| 3(b)(ii) | (X and Y have a) <u>constant</u> phase difference (of 180°) so (they are) coherent |
| 3(c) | A single wave of amplitude 10.0 cm |
| | A single negative sine wave of wavelength 0.40 m |
| 3(d) | $I \propto A^2$<br><br>$\frac{I_X}{I_Y} = 10^2 / 20^2$ |
| | ratio = 0.25 |



**Question 25** (Answer: **B**)

- First the wavelength: $\lambda = v/f = 600/300 = 2.0$ m.
- The two points are 0.50 m apart, which is a quarter of a wavelength.
- A whole wavelength is 360°, so a quarter is 90°.