Chapter 15 Sound. (Revision Questions page 428). Multiple Choice Answers

Q	Ans	Explanation
1	B	They have to be in opposite directions otherwise they will never overlap (as they have to travel at the same speed in the same medium). If they don't have the same frequency and amplitude there will be only partial destructive and constructive interference.
2	B	Strings produce all harmonics so if 100 Hz is the 1st harmonic (= fundamental frequency) the next harmonic will be the 2nd which has double the frequency. The number of the harmonic tells you how many times it is as a multiple of the 1st harmonic. You can use the strings and open pipe formula to show this: $L = n\frac{\lambda}{2} = n\frac{v}{2f}$ $f = n\frac{v}{2L}$ $f_{n=1} = 1\times\frac{v}{2L} = 100\,Hz$ $f_{n=2} = 2\times\frac{v}{2L} = 200\,Hz$ [L and v are constant]
3	C	$L = n\frac{\lambda}{2} = n\frac{v}{2f}$ $f_{initial} = n\frac{v_{initial}}{2L} = \frac{v_{initial}}{2L}[\,for\ fundamental, n=1]$ $f_{final} = \frac{v_{final}}{2L} = \frac{2v_{initial}}{2L}$ when $v_{final} = 2\times v_{initial}$ $f_{final} = 2\times\left[\frac{2v_{initial}}{2L}\right]$ $f_{final} = 2\times f_{initial}$
4	B	We know that closed pipes produce odd harmonics, so if the 1st harmonic (f_1) is at 80 Hz, the next harmonic will be at 3 x f_1 = 3 x 80 = 240 Hz. This is what the question says as the next harmonic so the pipe must be closed. We can prove this by considering whether the information supplied fits the open pipe or closed pipe formula. Open pipe $L = \frac{n\lambda}{2} = \frac{nv}{2f}$ $f = \frac{nv}{2L}$ $f_1 = \frac{1\times v}{2L} = 80\,Hz$ $f_2 = \frac{2\times v}{2L} = 2\times 80 = 160\,Hz$

		The next harmonic after the fundamental for an open pipe is 160 Hz, which is not what the data in the questions says. It is not an open pipe. Closed pipe $L = \frac{(2n-1)\lambda}{4} = \frac{(2n-1)v}{4f}$ $f_n = \frac{(2n-1)v}{4L}$ $f_{n=1} = \frac{(2\times1-1)\times v}{4L}$ [$fundamental, n = 1$] $f_{n=1} = \frac{1\times v}{4L} = 80 Hz$ $f_{n=2} = \frac{(2\times2-1)\times v}{4L} = \frac{3\times v}{4L}$ $= 3\times f_{n=1}$ $= 3\times 80 Hz$ $= 240 Hz$ This agrees with the data, so the pipe is closed. Now to work out the length. It is a closed pipe so: $L = \frac{(2n-1)\lambda}{4} = \frac{(2n-1)v}{4f}$ When $n = 1$, $f = 80$ Hz, and $v = 320\, m\, s^{-1}$ $L = \frac{(2n-1)\lambda}{4}$ $= \frac{(2n-1)v}{4f}$ $= \frac{(2\times1-1)\times 320}{4\times 80}$ $= 1.0\, m$

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5	B	L = 4, m = 60 g, f = 330Hz, λ = 0.2 m, A = 7.0 mm Velocity of the wave in the wire is $v = f\lambda = 330 \times 0.2 = 66\,m\,s^{-1}$ The time taken for the wave to travel in the wire: $v = \frac{s}{t}$ $t = \frac{s}{v}$ $= \frac{4.0}{66} = 0.061s = 61 \times 10^{-3} s$ $= 61ms$