YEAR 12 PHYSICS

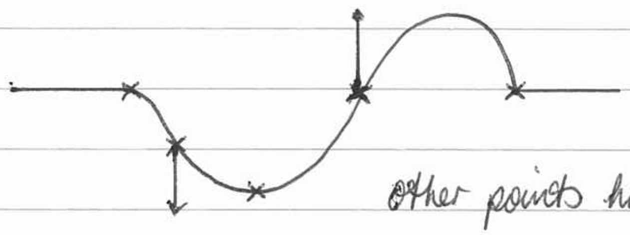
ASS 6 - SOUND

1.

MECHANICAL	ELECTROMAGNET	
sound	radio	
water waves	microwaves	
	X-rays	(2)

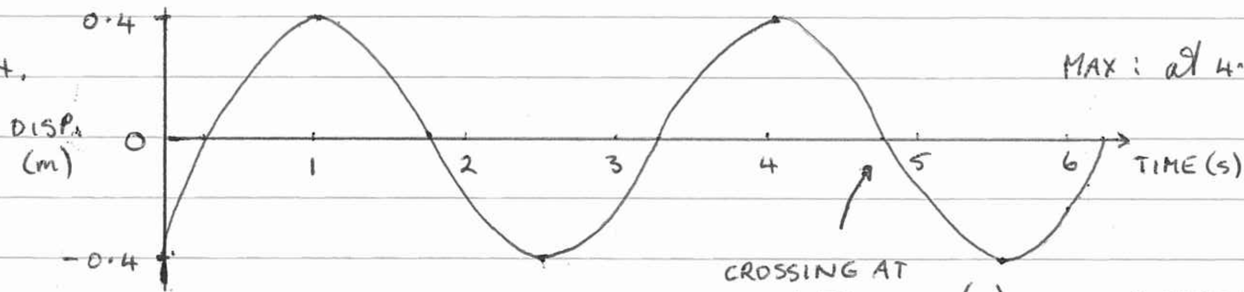
2. The lines represent a standing wave in the tube.
They show the maximum displacement of the particles.
It represents the third harmonic. (3)

3.



other points have no motion. (2)

4.



MAX: at 4·0, 5·5 s. (2)

CROSSING AT 4·75 s. (1) SHAPE: (1).

5. (a) Beats (1)

(b) These occur when two sources produces frequencies that are slightly different.
This difference must be less than 10 Hz for the ear to detect it. (2)

6.

$L = 10 \log \frac{I}{I_0}$

$\Rightarrow 88 = 10 \log \frac{I}{1{\cdot}00 \times 10^{-12}}$

$\Rightarrow 6{\cdot}310 \times 10^{8} = \frac{I}{1{\cdot}00 \times 10^{-12}}$

$\Rightarrow \underline{I} = 6{\cdot}310 \times 10^{-4}\ Wm^{-2}$

(1)

$L = 10 \log \frac{I}{I_0}$

$\Rightarrow 94 = 10 \log \frac{I}{1{\cdot}00 \times 10^{-12}}$

$\Rightarrow 2{\cdot}512 \times 10^{9} = \frac{I}{1{\cdot}00 \times 10^{-12}}$

$\Rightarrow \underline{I} = 2{\cdot}512 \times 10^{-3}\ Wm^{-2}$

(1)

$\therefore$ Intensity of both vehicles $= 6.310 \times 10^{-4} + 2.512 \times 10^{-3}$

$= 3.143 \times 10^{-3}\ Wm^{-2}$ (1)

$$L = 10 \log \frac{I}{I_0}$$
$$= 10 \log \frac{3.143 \times 10^{-3}}{1.00 \times 10^{-12}}$$
$$= 94.97\ dB$$

$\therefore$ New sound level = 95.0 dB. (1)

7. (a) 3 SPEAKERS : $L_1 = 88.5 = 10 \log \frac{I_1}{I_0}$

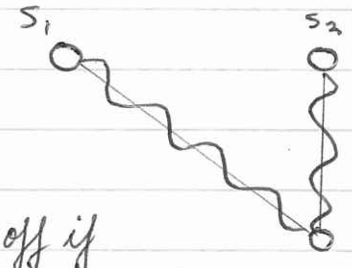
1 SPEAKER : $I_2 = \frac{1}{3} I_1$ (1)

$$\therefore L_2 = 10 \log \frac{(\frac{1}{3} I_1)}{I_0}$$
$$= 10 \log \tfrac{1}{3} + 10 \log \frac{I_1}{I_0} \quad (1)$$
$$= -4.771 + 88.5$$
$$= 83.73\ dB.$$

$\therefore$ Sound level = 83.7 dB (1)

* can be done calculating I_1, then I_2 and converting to L.

(b)

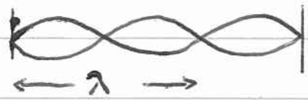


I mark off if no diagram or diagram is no use.

There is a "path difference" between O and S_1 and S_2. (1)
The waves are out of phase at O. (1)
Destructive interference occurs so the sound level is lower. (1)

(c) (i) "Loops" can be seen in the vibrating string with nodes that don't appear to move. (1)

(ii) Two waves of equal amplitude, wavelength and speed travelling in opposite directions in the same medium.
Waves reflect backwards/forwards from the two fixed ends. (2)

(iii) 

Set the string vibrating.
Either measure the distance between three nodes or double the distance between successive nodes. (2)

8. (a) $L = 10 \log \frac{I_1}{I_0}$

$\Rightarrow 90.0 = 10 \log \frac{I_1}{1.00 \times 10^{-12}}$ (1)

$\Rightarrow I_1 = 1.00 \times 10^{-3}\ \mathrm{W m^{-2}}$

$\therefore$ Intensity at meter $= 1.00 \times 10^{-3}\ \mathrm{W m^{-2}}$ (1)

(b) $I_2 = 3 \times I_1$
$= 3.00 \times 10^{-3}\ \mathrm{W m^{-2}}$ (1)

$L = 10 \log \frac{I_2}{I_0}$
$= 10 \log \frac{3.00 \times 10^{-3}}{1.00 \times 10^{-12}}$

$= 94.77\ \mathrm{dB}$

$\therefore$ New sound level $= 94.8\ \mathrm{dB}$. (1)

(c) DOLPHINS $v = f\lambda$

$\Rightarrow \lambda = \frac{1.53 \times 10^{3}}{1.00 \times 10^{5}}$
$= 1.530 \times 10^{-2}\ \mathrm{m}$

$\therefore \lambda = 1.53 \times 10^{-2}\ \mathrm{m}$. (1)

BATS $v = f\lambda$

$\Rightarrow \lambda = \frac{346}{1.50 \times 10^{5}}$
$= 2.307 \times 10^{-3}\ \mathrm{m}$.

$\therefore \lambda = 2.31 \times 10^{-3}\ \mathrm{m}$. (1)

* Be lenient with the speeds. They come from the data sheet.

(d) When a "fluttering" is heard, the two frequencies are slightly different and beats occur.
No beats are heard when the frequencies are the same. (2)

(e)

$l_1 = \frac{1}{2}\lambda_1$

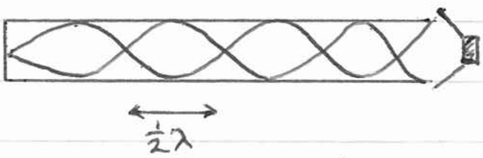
$l_2 = \frac{1}{2}\lambda_2$

A tuba is a longer air column.
At the first harmonic, it has a larger wavelength (λ_2) (1)

If the speed of sound is the same: $v = f_1\lambda_1 = f_2\lambda_2$

$\Rightarrow$ If λ_2 increases, f_2 is smaller than f_1 (1)
$\Rightarrow$ It has a lower pitch.

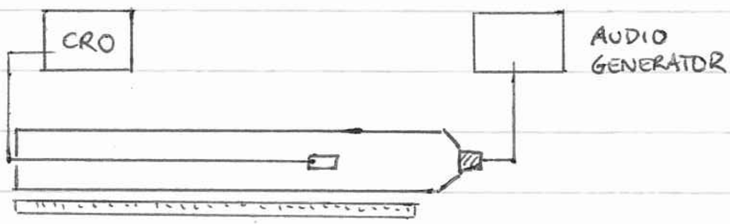
9 (a)



The speaker generates a standing wave in the closed pipe. (1)

Nodes occur every $\frac{1}{2}\lambda$ (1).
$\lambda = 2 \times$ distance between nodes. (1)

(b)



(2)

(c)

f	NODE 1	NODE 2	λ
		AVERAGE	

Several trials should be averaged for a given frequency.

Several harmonic frequencies should be used. (3)

10 (a) Plot l against $\frac{1}{f}$ (2)

(b) EQN: $y = 88.6x - 3.26 \times 10^{-2}$ (3)

* Be liberal with the equation but it should be close to this.

(c) (i) slope $= \frac{l}{\frac{1}{f}} = \frac{v}{4}$ (1)

$\Rightarrow 88.6 = \frac{v}{4}$ (1)

$\Rightarrow \underline{v = 354 \text{ ms}^{-1}}$. (1)

(ii) $e = 3.26 \times 10^{-2}$ m (1)

TOTAL: $\overline{56}$.