SCOTCH COLLEGE YEAR 11

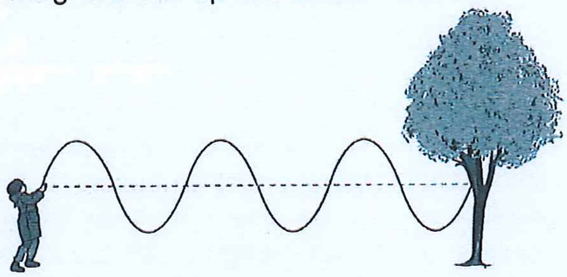
WAVES TEST 2016

Time = 50 mins Total Marks = [50 marks]

NAME: ______________________________

Question 1 **(2 marks)**

You can make a wave move along a piece of rope by moving one end up and down. At a particular instant, the shape of such a rope is as shown in the diagram. Estimate the amplitude and wavelength of the wave moving along the rope. (no explanation required)



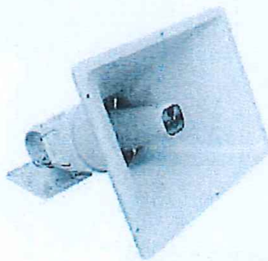
Amplitude: 0·5m (±0·2m) ✓

Wavelength: 2·0m (±0·5m) ✓ 1·5m

Estimate of ht = 1·5m.
ie 1cm = 1m.

Question 2 **(2 marks)**

A diffraction horn is a special type of loudspeaker that is designed to produce a wide spread of sound into a listening area. Using your knowledge of diffraction suggest how this type of loudspeaker is able to produce a wider spread of sound.



× The speaker is designed so that sound waves emerge from the front opening ✓

× The design encourages diffraction and thus a wider spread of sound waves. ✓

4

Question 3

(9 marks)

There are a number of statements below, some which refer to standing waves only (S), some which refer to travelling waves only (T) and some which are common to both wave types (B). Complete the table below by inserting tick in the appropriate cells. If the statement does not apply, then leave the cell blank.

STATEMENT	Properties of		
	S	T	B
No energy is transferred..	✓		
All oscillations have the same amplitude.		✓	
Energy is transferred through the medium.		✓	
All oscillations have the same frequency.			✓
Amplitude varies with position.	✓		
All oscillations have a different frequency. (All blank)			
Wavelength is twice the distance between adjacent nodes	✓		
Wavelength is the shortest distance between two points in phase.		✓	
Oscillations between adjacent nodes are in phase.	✓		
Oscillations one wavelength apart are in phase.		✓	

(1 each)

Question 4

2 **(~~4~~ marks)**

Calculate the wavelength in air of a high-pitched sound of frequency 3250 Hz if the speed of sound in air is 340 ms^{-1}.

$f = 3250\ Hz$
$v = 340\ ms^{-1}$
$\lambda = ?$

$v = f \times \lambda$

$\Rightarrow 340 = 3250 \times \lambda$ ✓✓

$\Rightarrow \lambda = \frac{340}{3250}$

$= 1.05 \times 10^{-1}\ m$ — (×)

Question 5

(4 marks)

(a) Briefly explain why a middle C on a sax sounds different to a middle C on a piano?

Different instruments will produce different overtones more or less prominently. This blend produces the final note and is the timbre of the instrument. ✓✓

(b) What Physics terminology (word) best describes **Pitch** and **Loudness?**

Pitch: Frequency ✓ **Loudness:** Amplitude ✓

15

Question 6 **(5 marks)**

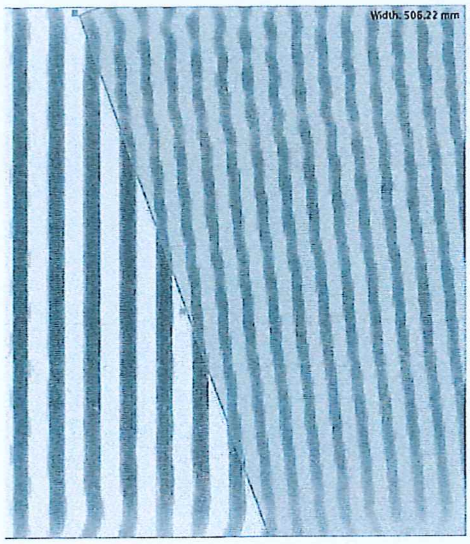
a) You are walking along a path on a cliff about a surf beach. The path is not quite on the cliff edge, so you cannot actually see the surf, nor can you see the seagulls that are flying below the cliff.

Explain why you **can** hear the pounding of the surf, but you **cannot** see the seagulls.

× The sound produced by the waves have a lower frequency (bigger λ) than the ~~sound~~ Light from the gulls. ✓

× Low frequency sounds diffract better/more so can bend around top of the cliff and can be heard. ✓

b) The diagram at the right shows a series of wave crests transitioning from deep water to shallower water.



DEEP WATER SHALLOW WATER

i). Does the wave speed up or slow down when it enters shallow water?

slow down ✓

ii). What wave behaviour is illustrated in the diagram?

Refraction ✓

iii). What property of the wave is unchanged as it enters the shallow water?

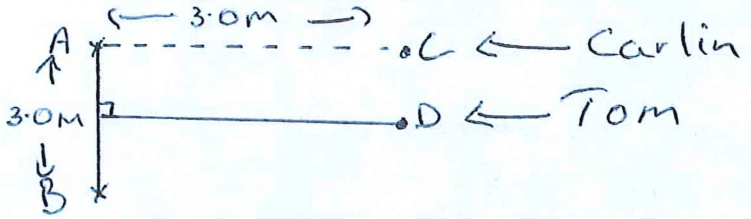
frequency ✓

5

Question 7 (From Study Guide) **(7 marks)**

Tom and Carlin connect two speakers (labeled A and B) to a single frequency wave generator in order to investigate the loudness of the sound produced at different points in the Science laboratory. The speakers are 3.00 m apart and Tom stands at a position D, which is exactly midway between the speakers and at a perpendicular distance from them. Carlin is standing at position C, which is directly in front of speaker A, 3.00 m from it and directly in line with Tom.

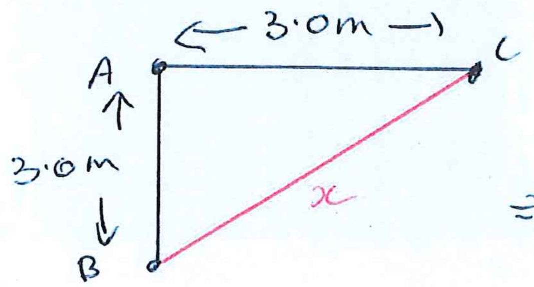
a) Draw a diagram that shows the situation described above.



b) If Tom starts to walk directly towards Carlin, in what way will the sound that he hears vary? Explain.

Tom is walking away from a point of max loudness. He will encounter a series of loud and quiet spots which are due to constructive and destructive interference from the two speakers

c) In his position, Carlin hears a very soft sound. Determine the minimum frequency of the sound being emitted by the two speakers (assume that the speed of sound is 340 ms^{-1}).



$x^2 = 3.0^2 + 3.0^2$

$\Rightarrow x = 4.24\ m$

$\Rightarrow$ p.difference $= 4.24 - 3.0$

$= 1.24\ m$

For soft sound p.difference $= \frac{\lambda}{2}$

$\Rightarrow 1.24 = \frac{\lambda}{2}$

$\Rightarrow \lambda = 2.48\ m$

$v = f \times \lambda$

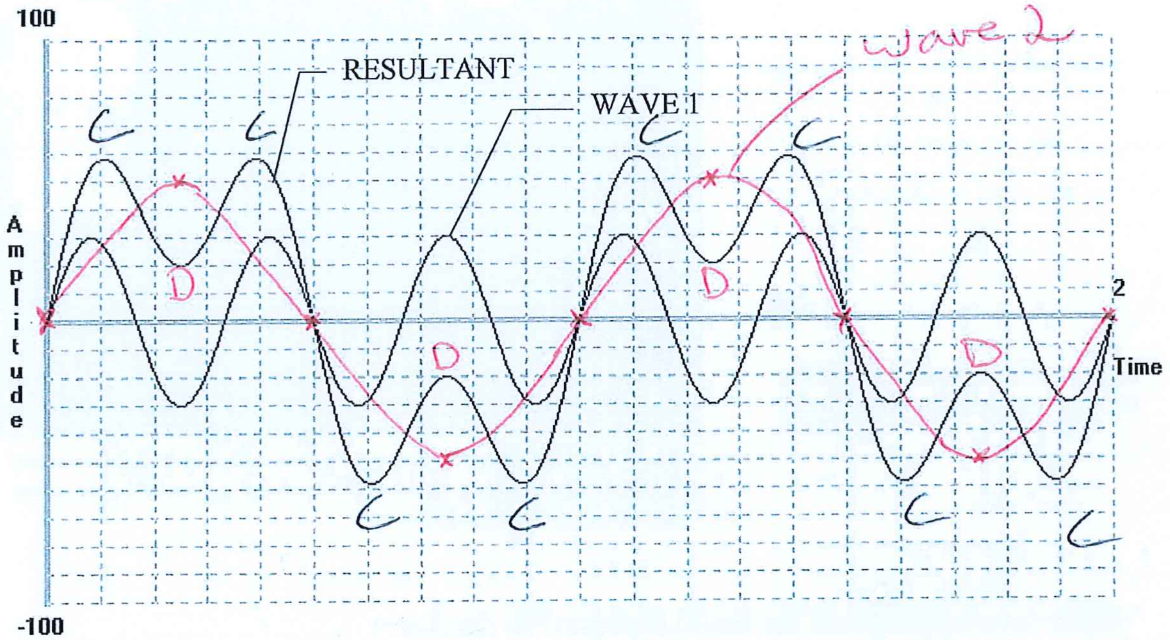
$\Rightarrow 340 = f \times 2.48$

$\Rightarrow f = 137\ Hz.$

7

Question 8 **(5 marks)**

The picture below shows the resultant of two waves, WAVE 1 (shown) and WAVE 2 (not shown). Study the picture carefully, and answer the questions that follow.



a) Sketch WAVE 2, so that the resultant of WAVE 1 and WAVE 2 is as shown above.

b) Complete the following information about WAVE 1, WAVE 2 and the RESULTANT

	WAVE 1	WAVE 2	RESULTANT
AMPLITUDE	30	56	60
FREQUENCY	3	1	1
PERIOD	0.33	1	1

c) Label with a "C" all points of **maximum constructive interference.**
Label with a "D" all points of **maximum destructive interference**

4

7

Question 9

(7 marks)

An organ pipe, such as that shown at right is open at both ends and has a second harmonic of 228 Hz.

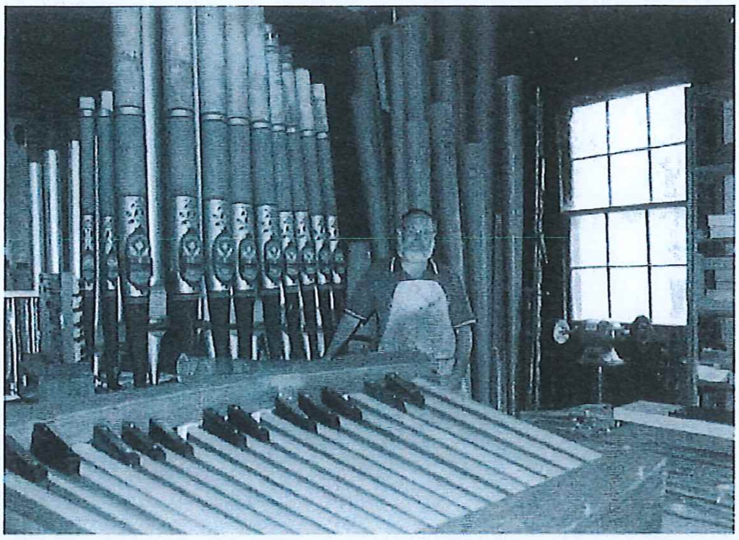
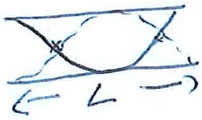


Figure 1: Organ builder John Larner has this week spoken to The eRecord following the tragic loss of his home and livelihood in the Yarloop and Waroona fires

a) What is the length of this pipe?



$L = \lambda$

$v = f \times \lambda$

$\Rightarrow 346 = 228 \times \lambda$

$\Rightarrow \lambda = 1.52$ ✓

$\Rightarrow L = 1.52\,m$ —(*)

b) What is the frequency of the third harmonic for this pipe?

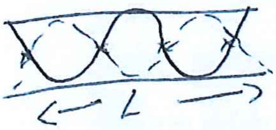
$f_0 = 228/2$

$= 114\,Hz$ ✓

$\Rightarrow 3f_0 = 3 \times 114$

$= 342\,Hz$ ✓

c) What is the wavelength of the fourth harmonic for this pipe?



✓

$L = 2\lambda$

$\Rightarrow 1.52 = 2\lambda$

$\Rightarrow \lambda = 0.76\,m$ —(*) ✓

d) Suggest one advantage of using organ pipes that are closed at one end, rather than open at both ends.

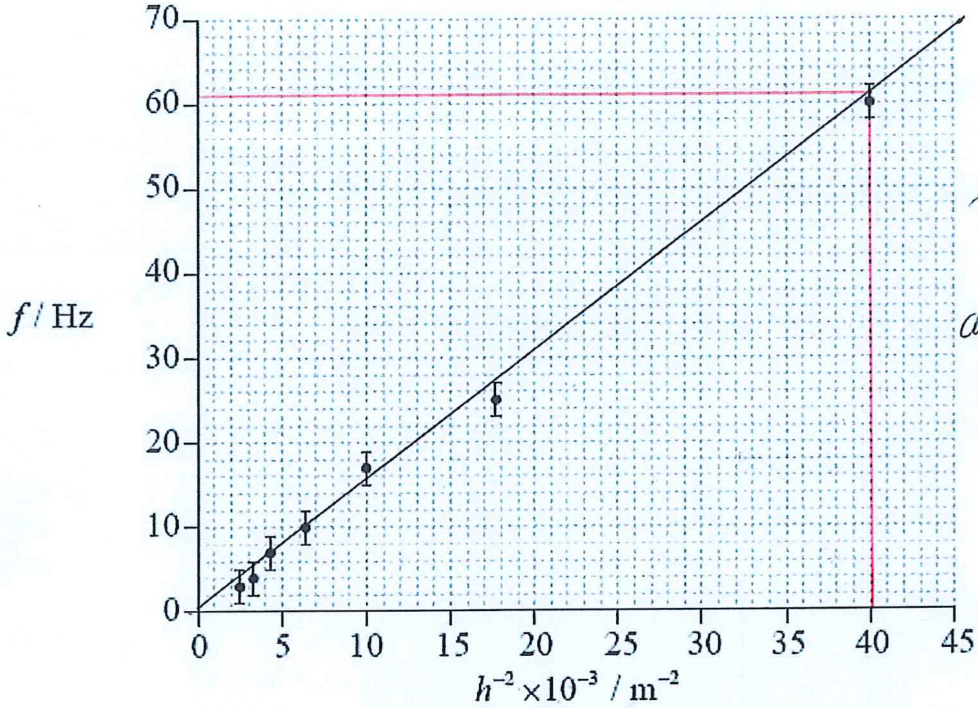
To produce the same fundamental frequency they can be half the length of pipes open at both ends. ✓✓

7/7

b) Another suggestion is that the relationship between f and h is of the form shown below,

$$f = \frac{k}{h^2}$$ where k is a constant.

The graph below shows a plot of f against $1/h^2$.



✓

Through 0,0 and all E. bars

c) Draw a best-fit line for the data that supports the relationship and determine, using the graph, the constant k.

$f = \frac{k}{h^2}$

$\Rightarrow y = m x$

$f = k \times \frac{1}{h^2}$

k is gradient.

gradient $= \frac{\text{rise}}{\text{run}}$

$= \frac{61}{40}$

$\Rightarrow k = 1.5$ Hz m^2 ✓ ✓

(must have unit or 1:!)

3