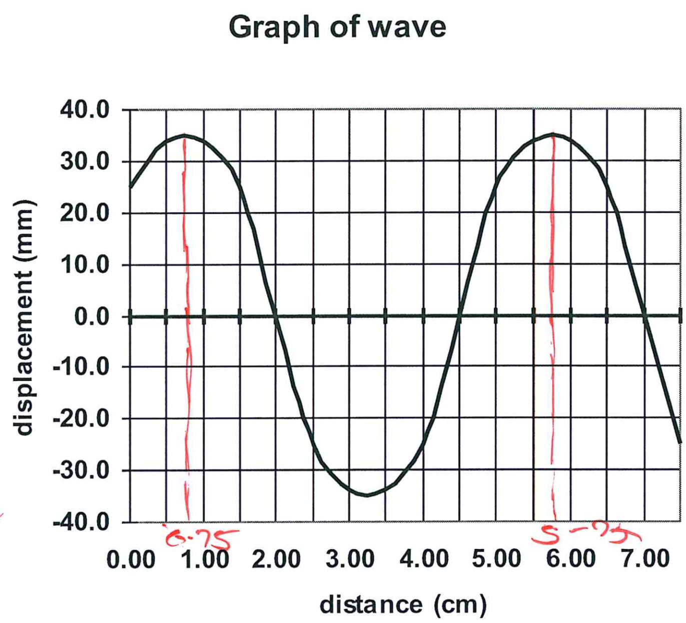
Physics Unit 2:
Mechanical Waves Test (Sound)

Name: ____ (45 marks)

1. Three students are using a piece of string to make a standing wave. The following graph shows the wavelength of part of the string at one particular instance. What is the amplitude and wavelength of the wave the string creates. (2 marks)

   Amplitude 35 mm

   Wavelength 5cm



2. If the wave in the graph for question (1) is travelling at 4.00 ms^{-1}, what is the period of the wave? (3 marks)

$v = f\lambda$

$f = \frac{v}{\lambda} = \frac{4}{0.05} = 80\text{Hz}$ ✓

$T = \frac{1}{f} = \frac{1}{80}$ ✓ $= 0.0\cancel{1}\cancel{5}125\,s$ ~~m/s~~

$= 1.25 \times 10^{-2}\,s$ ~~m/s~~ ✓

3. Complete the following: (3 marks)

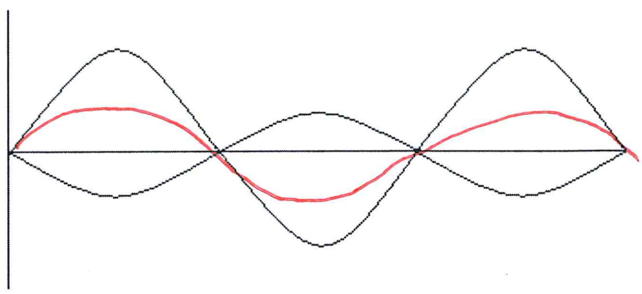
   a. In a region of stationary waves, nodes indicate no vibration of particles.

   b. The number of waves in a given time. frequency

   c. The distance between two crests on a displacement / time graph is called the Period.

4. Waves can travel as longitudinal waves or transverse waves. Fully explain the difference giving one example of each. (3 marks) Transverse waves vibrate perpendicular to the line of travel, an example is light.
Longitudinal waves vibrate along the line in which the energy travels, an example is sound

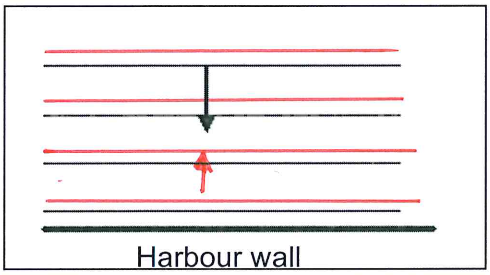
5. A student has set up two waves on a dual beam CRO. She then adds them together. Draw the resultant wave. (2 marks)

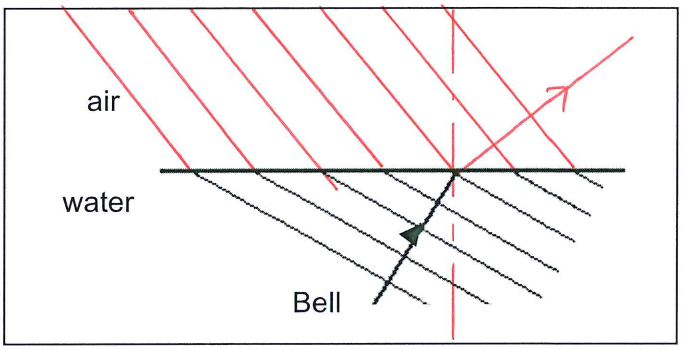


6. Bending of waves due to passing around or through openings is called diffraction

(1 mark)

7. Complete the following diagrams for reflection of waves at harbour wall and refraction of sound of bell above water. (3 marks)





8. Matt starts by running his finger around the top of a wine glass. He then increases the speed until it sounds a note. Explain why the glass sounds the note and what is the name given to this phenomena. (3 marks)

name: resonance

running your finger around the ~~hot~~ glass adds energy to the glass, this makes the glass vibrate at its natural frequency

9. Andrew is blowing air over the end of a pipe. When he blows softly across the end, a microphone connected to a C.R.O. shows a frequency of 256 Hz. When he blows over the pipe much harder, a frequency of 1024 Hz is shown on the screen. The speed of sound on the day is 332 ms^{-1}.

a. Is the pipe open at both ends or open at one end and closed at the other? (1 marks)

open

b. Fully explain the answer you gave. (3 marks)

the ratio is $\frac{1024}{256} = 4$

Closed pipes only resonate at odd intervals

This is even, there it must be open.

c. What is the length of the pipe assuming the 256 Hz is the fundamental frequency? (2 marks)

$\lambda = \frac{2L}{n}$

$\lambda = \frac{v}{f}$ $\quad v = 332\ m/s$ $\quad f = 256$ $\quad n = 1$

$= \frac{v}{f}$

$= \frac{332}{256} = 1.3\ m$

$\lambda = \frac{2L}{n}$

$\Rightarrow L = \frac{\lambda n}{2}$

$= \frac{1.3 \times 1}{2}$

$= 0.648\ m$ long

10. A closed pipe is 40.0 cm long and is made to vibrate in its fundamental frequency. What is the period of the wave? (3 marks)

$\lambda = \frac{4L}{(2n-1)}$ ✓ $L = 0.4\,m$ $n = 1$

$= \frac{4 \times 0.4}{1}$

$= 1.6\,m$

$f = \frac{v}{\lambda}$ assume $v = 340\,m/s$

$= \frac{340}{1.6}$

$= 212.5\,Hz$ ✓

$T = \frac{1}{f}$

$T = 4.71 \times 10^{-2}\,s$ ✓

11. Imagine a situation in which a sound wave, with a wavelength of 1.6 m is reflected straight back from a flat wall, forming a standing wave pattern. You are walking towards the wall. As you approach the wall:

a) What is the shortest distance you need to move to go from one "quiet spot" to the next?

$\lambda/2 = \frac{1.6}{2} = 0.8\,m$ ✓ ✓

(2)

b) What is the position of these "quiet spots" called? nodes

(1)

c) What is the position of the "loud spots" called? anti-nodes

(1)

d) What is the separation distance between a "quiet spot" and a "loud spot"?

$\lambda/4 = 1.6/4 = 0.4$ meters

(2)

12. A dolphin's social vocal range is 1 – 50 kHz, while it's echolocation frequency can go as high as 150kHz, whereas most bat's echolocation frequencies are approximately 100,000 Hz

a) If the speed of sound in the sea is 1500 m/s what is the smallest object that can reflect the dolphin's sonar wave?

$v = 1500\,m/s$ ✓ $\lambda = v/f$

$f = 150{,}000$

$= 1500/150{,}000$ ✓

$= 0.01\,m$ ✓

(3)

b) Compare the dolphin's minimum detected object compared to a bat's minimum detected object while the bat is hunting prey?

$\lambda_{Bat} = \frac{v}{f}$ $v = 340 m/s$ (assume)

$= 340 / 100{,}000$ $f = 100{,}000$ Hz

$= 3.4 mm$ ✓

$\lambda_{dolphin} / \lambda_{bat}$

$10 / 3.4$

2.94 times less accurate than a bat's

✓(2)

13. An ambulance started its siren 200m after leaving the scene of an accident. After a short time the intensity of the sound was measured as being 15% of the original. Assuming the volume of the siren hadn't changed how far away was the ambulance when the intensity was measured.

$I \propto \frac{1}{r^2}$ let $I_1 = 1$

& $\frac{I_2}{I_1} = \frac{r_1^2}{r_2^2}$ $I_2 = 0.15$

$r_1 = 200$

$\Rightarrow r_2 = \sqrt{\frac{r_1^2 \times I_1}{I_2}}$ $r_2 = ?$

$r_2 = \sqrt{\frac{200^2 \times 1}{0.15}}$

$= 516 m$

(3)

14. What are the advantages of using very high frequency ultrasounds compared to using lower frequencies ultrasounds in medical uses.

can see smaller details than larger wavelengths. ✓
Ultra sounds can be used to break up unwanted objects in the body. ✓ as well as imaging internal structures of the body ✓

(3)