Saigon International College

AEPHY

Test #6

Waves

Task Weighting: 5% of the school mark for this pair of units

Time: 70 minutes

Student Name: Chu Minh Đăng

Score: 50/62

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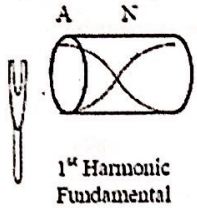
Question 1 (5marks)

5

The figure below represents the 1st harmonic for an open pipe. The length of the pipe is 40 cm.

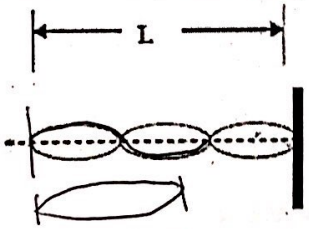


I) What is the wavelength of the sound wave resonating in the pipe?

A) 80 cm
B) 160 cm
C) 20 cm
D) 10 cm
E) 40 cm

For the next two questions ii) and iii), use the diagram below:

A standing wave is produced in a string when a periodic wave is passed through the string and is reflected off the fixed end, as in the diagram below.



$\frac{2}{3} \times \frac{2}{1} = \frac{4}{3} = 1\frac{1}{3}$ m

ii) If the total length of the (L) of the standing wave is 2.0 m, then the wavelength of the wave is most nearly:

A) 0.5 m
B) 1.33 m
C) 1.67 m
D) 1.0 m
E) 3.0 m

L = 2

iii) How many nodes and antinodes does the standing wave have?

A) 4 nodes, 3 antinodes
B) 3 nodes, 6 antinodes
C) 2 nodes, 4 antinodes
D) 4 nodes, 6 antinodes
E) 6 nodes, 3 antinodes

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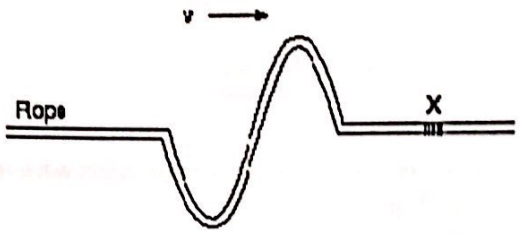
iv) As shown in the diagram below, a transverse wave is moving with velocity v along a rope. In which direction will segment X move as the wave passes through it? [1]

A) down only
B) up only
C) down, then up, then down
D) up, then down, then up



v) Sound is an example of a(n)
A) a shock wave
B) reflection
C) interference
D) longitudinal wave
E) refraction

Question 2 (7mark)

Fill in the blank space with only one appropriate word. One mark for each correct answer.

a) For a traverse wave, the particle movement is perpendicular to the direction of the motion of the wave.

b) A longitude wave has particle movement that is parallel to the direction of motion of the wave.

c) According to the law of refraction, waves bend towards the normal if they enter a medium where their speed is slower.

d) Diffraction of waves is greatest when the wavelength is larger than the opening or obstacle.

e) constructive interference is when two waves combine to create a greater resultant of displacement.

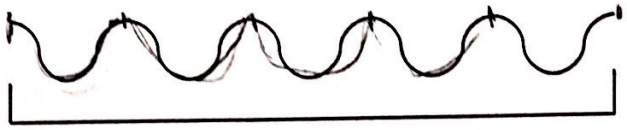
f) Whenever the frequency of a forcing vibration is equal to the natural frequency of the vibrating object, it is called resonance.

g) For standing waves, nodes are located where there is no, 0 displacement.

Question 3 (3mark)

3

If the distance between crests of water waves is 60 cm and the frequency of the wave source is 3 Hz, find the velocity in ms^{-1} of the wave.



$f = 3$
$\lambda = 12$

5 waves
0.12 cm/wave

$v = f\lambda$
$v = 3 \times 0.12$
~~$v = 36.0\ ms^{-1}$~~ $v = 0.36\ ms^{-1}$

Question 4 (2marks)

1

Ms Chau is investigating how the intensity of the sound produced by an alarm bell varies with distance. When she is 5.0m from the bell, she finds the intensity to be $2.85 \times 10^{-2}\ Wm^{-2}$. If we assume no effects from sound reflections or absorption, determine the likely intensities the Ms Chau will find at a distance of 20.0m from the bell.

$I = 2.85 \times 10^{-2}$
$5 = 5\ m$

$I_1 r^2 = I_2 r^2$
$2.85 \times 10^{-2} \times 5^2 = 20^2 \times I$
$I = 1.78 \times 10^{-3}$

-1 units

Question 5 (4marks)

2

A dolphin emits a high frequency sound wave that travels through the water. The dolphin hears the echo 0.8 seconds later as it reflects off a fish. What is the distance between the dolphin and the fish (assume the speed of sound in water is $1480\ ms^{-1}$)

$v = 1480$

Show working

$0.4 \times 1480 = 592\ m$

or

590 m

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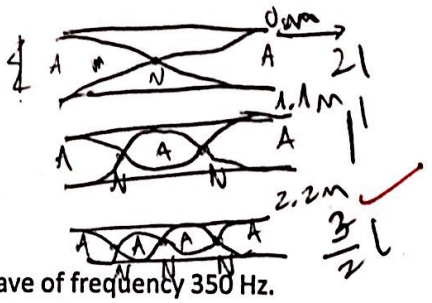
Question 6 (3marks)

A 440 Hz tuning fork is used with a resonating column (open pipe) to determine the velocity of sound in hydrogen gas. If the spacing between harmonics is 110 cm, what is the velocity of sound in hydrogen gas?



Question 7 (3marks)

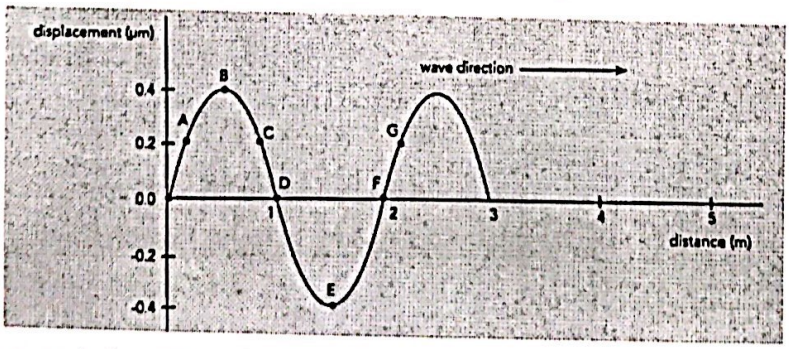
A device of a submarine at the bottom of the sea emits a sound wave of frequency 350 Hz.

(i) Calculate the period [1]

(ii) The sound wave passes from the sea-water and into the air. State what happens, if anything, to

- the frequency of the sound, ... [1]
- the speed of the sound. ..... [1]

Question 8 (6marks)



From the graph determine the following:

a) Amplitude
b) Wavelength
c) Two points in phase
d) Two stationary points
e) A point moving away from its mean position
f) Two points moving with greatest speed

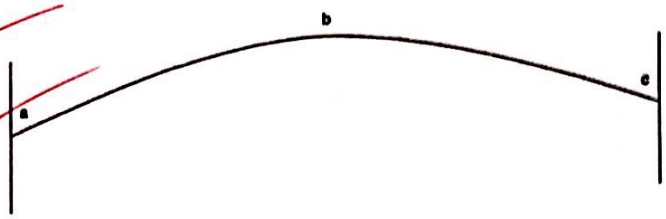
Question 9 (4 marks)

The diagram below shows a string 250 cm long vibrating in its fundamental mode between two fixed points.

4

i) For each of the positions **a**, **b**, and **c**, indicate whether these are nodes or antinodes. [2]

a: Nodes
b: Antinodes
c: ~~Ant~~ Nodes



ii) The string is vibrating with a frequency of 100 Hz. Calculate the speed of the wave. [2]

$f = 100Hz$ $v = f\lambda$ $\lambda = 2l$

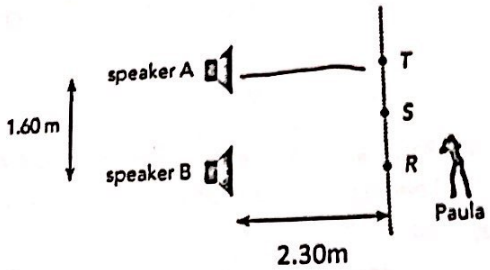
$v = 5 \times 100$ $\lambda = 2 \times 2.5$

$v = 500 ms^{-1}$ $\lambda = 5.0m$

5

Question 10 (10marks)

Paula and Jake connect two similar speakers (A and B) to a sound frequency generator so that each speaker will emit sounds that are in phase and of equal frequency and intensity. They investigate the intensity of the sound produced at points along a line parallel to the speakers (2.30m away). They use a frequency of 685 Hz. Dimensions of the layout of the experiment are shown below.



Paula walks along the line from R to T and notices that the maximum sound intensities occur at R and T (directly in front of the speakers) and at S (a point mid-way between each speaker). Quieter spots are noticed in between.

a) What is the cause of the louder and quieter spots? Explain clearly. [2]

There are ~~faint~~ points where the sound from speaker A and speaker B reinforce (get louder) or destructively interfere with each other (get quieter). When Paula walks ~~the~~ through these points, she will hear that there are louder and quieter spots.

(1) "Standing wave pattern creates fixed spots of constructive interference."

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b) From the diagram determine the difference in the distant between *AT* and *BT*. [3]

AT: 2.3m (from diagram)

BT: 2.3m, 1.6m, ? = 2.80m

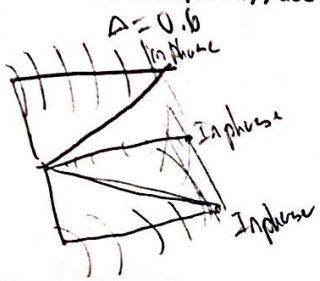
2.8
2.3

2.80 − 2.3 = 0.60m

= in phase

0.5m.

c) Use the results from part b) to determine the velocity of the sound during this experiment. [If you could not calculate a value from part b), use 0.6m] [3]



$v = f\lambda$

$v = f\lambda$

$v = 685 \times 0.1$

$v = 68.5\ ms^{-1}$

$f = 685$

$v = ?$

$\lambda = ?$ 0.6m 0.1m

$\lambda = 0.1$

2.8
2.3
0.6

d) Paula and Jake decide to double the frequency of the sounds from each of the speakers while keeping the intensities the same. Describe the difference that Paula will notice as she walks from point *R* to point *T*. [2]

She would hear alternating soft and loud sound more often as there would be more points of complete in phase and out of phase that as she walks she would hear more alternating soft and loud sounds

why? (1)

3

Question 11 (3marks)

A steel tube of length 3.0 m has a gas from an industrial plant passing through it causing the tube to be subjected to transverse vibrations. The speed of the transverse wave along the steel pipe is 400 m s^{-1}. Calculate the lowest frequency of standing waves that can form in the tube.

$\lambda = 2l$ $\lambda = \frac{2}{3}l$ $\frac{2}{3} \times 3 = 2m$

$v = f\lambda$

$400 = f\ 2L$

$400 = f\ 6$

$v = 400$

$\frac{400}{6} = 66.7\ Hz$

Question 12 (12marks)

Locating earthquakes

The actual location of a seismic event such as an earthquake can be found if the seismic recordings from at least three recording stations are combined and analysed. Seismic waves are caused by events such as earthquakes and they travel through the earth's crust in different forms and varying speeds. Seismic waves travel through the earth's crust as both longitudinal and transverse waves.

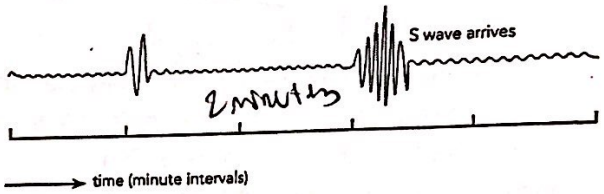
The longitudinal waves travel almost twice as fast as the transverse waves and are the first to a seismic event. They are referred to as P waves (primary). They tend to be heard rather than felt. Their velocity in the earth's crust can range between 4.0 km/sec to 8.0 km/sec., in water it is 1.5 km/sec and in air, the usual speed of sound, about 0.33 km/sec.

The transverse waves travel more slowly and are second to be felt. They are called S waves (secondary). These waves have more energy, move at right angles to their direction of travel and are generally more destructive. Their velocity in the earth's crust can range between 2.5 km/sec to 4.0 km/sec. S waves do not travel through liquids or air.

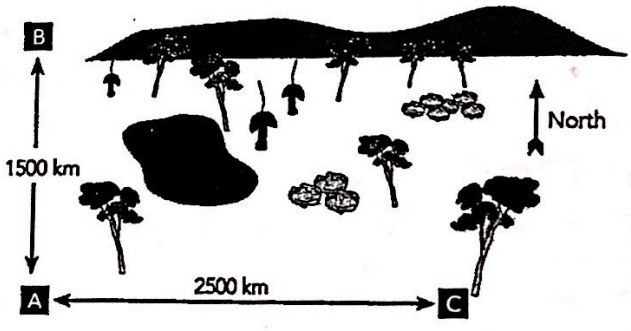
The difference in time of arrival between P and S waves provides a simple and direct way of calculating the distance of a seismic event. Conversion tables have been established by analysing data from many earthquakes and these give distances of about 9.0 km for every second of time difference. To find the actual location an earthquake event the first step is to find its distance from three different recording stations. These distances can then be plotted to scale as circles around each recording station. The epicentre is where the circles intersect.

The seismic recording from a recording station A is shown below. Similar recording were also made at two other stations B and C, located 1500 km due North and 2500 km due East of recording station A. Their relative positions are also shown below. Use all the information and data given to answer the following questions.

Seismogram – Recording station A



Seismic Stations



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a) Why do you think P waves (primary waves) are so called? [2]

Because it is the first wave to come be cause it is much faster than S waves

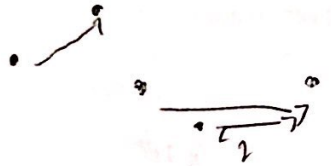
b) P waves tend to be both felt and heard while S waves can only be felt. Explain the likely reason for the difference. [2]

Because P wave are ~~transverse~~ longitudinal waves than can travel through solid, liquid and gas, while S wave are ~~fast~~ transverse waves that can ~~#~~ only travel through solids, so P wave can be both felt and heard, while S waves can only be felt

c) A seismogram for the arrival of P and S waves at recording station A is shown above. Use it to determine the time difference of the arrival of the P and S waves at recording station A. [2]

around 2 minutes 2.0 minutes or 120 seconds

d) Assuming a value of 9.0 kms^{-1} of S-P time difference. Calculate the distance of the seismic event from station A. [2]



2 × 60 = 120 s

120 s × 9 = 1080 km

1.08 × 10^6 m ← 1080000 km

e) Similar analysis of the recording stations B and C establish that they are 1200 km and 1750 km from the seismic event respectively. The relative locations of the stations A, B and C are in the diagram above. Use the graph below to show these locations to scale. Draw circles (to scale) to represent the distance of each station from the seismic event, and determine the approximate epicentre of the event. [4]

Answer? -1