**Applecross Senior High School**

**Year 11 Physics**



**Sound and Waves**

**Topic Test 2016**

**Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Instructions to candidates**

1. Do **NOT** write till you have been instructed.
2. This paper consists of Three sections, Section A, B and C. Section A carries 19 marks, Section B carries 21 marks and Section C is 10 marks.
3. Answer **ALL** questions in each section. Writing your answers in the space provided.
4. All calculations need to show full working out, if full marks are to be awarded.
5. Unless otherwise specified, numerical answers should be expressed to 3 significant figures.

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| --- | --- | --- | --- |
| **Section** | **Description No. Questions** | **Allocated Marks** | **Your Marks** |
| **A** | **Short Answer 5** | **19** |  |
| **B** | **Extended Answer 4** | **21** |  |
| **C** | **Comprehension 1** | **10** |  |
| **50** | **Total: = %** |

**Section A: Short Answer [19 marks]**

1. A ripple tank is used to generate transverse water waves as shown in the

Displacement - distance graph below.

Distance(cm)

Displacement(cm)

5

10

15

20

25

1.0

0

(a) Explain what is meant by the term "transverse wave". [2 marks]

(b) Determine;

(i) the wavelength of the wave: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii) the amplitude of the wave: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [2 marks]

(c) If the period of the waves is 4.2 seconds, calculate the speed of the wave. [2 marks]

1. Sandy explodes a firework at position A which is 400 m from Jane at position B.

Due to the echo from a wall Jane hears two bangs which are 0.48 seconds apart. Calculate the perpendicular distance from the wall to Jane.

[3 marks]

A (Sandy) B (Jane)

400 m

?

Wall

1. Jason is fishing from a jetty and notices his float on his fishing line bobs up and down as regular waves pass by. He counts 12 full oscillations of the float in one minute.
2. What is the period of the water waves? [2 marks]
3. If he estimates the wavelength as 5 metres, calculate the speed of the wave.

[2 marks]

1. An explosion on the ground sends sound waves from the air into a rocky wall.

The sound waves in air are shown in the diagram below.

1. Draw the sound waves into the rocky wall and complete the change in the properties of the wave as it passes into the rocky wall.

[2 marks]

normal

rock

air

sound waves

1. Name the wave behaviour being shown in the diagram. [1 mark]
2. Rebecca notices ripples are produced in a glass of water on a table at certain intervals during a song, even though the intensity of the sound produced stays constant. Explain how this phenomenon is caused using physics principles. [3 marks]

**Section B: Extended Answer [21 marks]**

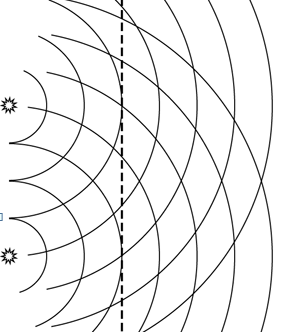
1. Victoria, a physics student, plucks a guitar string producing a standing wave in the string whose length is 61 cm. Assume the wave speed in the guitar string is 425 m s-1.
2. What is the lowest frequency that the guitar could produce? [2 marks]
3. Draw a diagram to show the standing wave pattern produced by the third harmonic.

Label the nodes and antinodes on your diagram. [2 marks]

1. What is the frequency of the third harmonic? (2nd overtone.) [2 marks]
2. Two speakers A and B, located 10.0 m apart are connected to the same sound source so that they produce identical sound waves (in phase) as shown on the diagram. The solid circular lines represent their wavefronts (peaks of the waves).

XY is a row of seating 8 m from the speakers.

X



Y

T

S

R

Q

P

B

A

1. What do the dotted lines, P, Q, R, S, and T represent on this diagram? Explain. [3 marks]
2. What would you hear if you walked along line XY trying to find your seat [1 mark]
3. Use the letter **C** to label **two** locations where **constructive** interference will occur.[1 mark]
4. Use the letter **D** to label **two** locations of **destructive** interference. [1 mark]

1. The sound from a tuba has a low frequency(less than 400 Hz) but the sound from a flute has a much higher frequency(up to 3000 Hz).

At a concert, the people queuing outside the open door of the hall are able to hear one of the instruments more clearly.



Queue of people

Doorway

Top view

1.5 m

(a) Which instrument will be heard more clearly? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [1 mark]

(b) Name the phenomenon that is responsible for this difference and explain.

Be sure to include wavelength in your explanation. [2 marks]

(c) A doorman at the hall now closes the door except for a tiny crack.

Clearly EXPLAIN the effect this will have on what instrument the people queuing can hear more clearly. [2 marks]

1. You can make a soft drink bottle resonate by blowing air over the top of it.   
   **ESTIMATE** the frequency of the lowest possible note that you could get from a 1.25 Litre soft drink bottle in this way.

Indicate any assumptions you make and show clearly how you obtained your estimate. [4 marks]

**Section C - Comprehension [10 marks]**

1. Read carefully the following report appearing in the New Scientist of the earthquake that shook Mexico City on 19 September 1985, and then answer the questions.

**Waves of destruction in Mexico City**

When the earthquake shook Mexico City on 19 September 1985, the worst-hit part of the city was an area that sits on the waterlogged sediments of an ancient lake. But within this area devastation was not uniform; buildings from 5 to 15 storeys high suffered the worst damage, and overall damage was distributed in alternate bands of heavy and light destruction.

All objects from piano strings to bridges and tower blocks have a resonant frequency at which they vibrate naturally. The 2-second period of the incoming shocks coincided with the resonance frequencies of tower blocks between 5 and 15 storeys high, which explains their vulnerability. But the zonation of damage suggests that these shock waves were reflected internally within the basin, interfered with each other and gave rise to standing waves (Nature, Vol 326, p 783).

Tremors are a complex mixture of up-and-down or side-to-side "shear” waves and back-and-fore “pressure" waves. Only the pressure waves move well through fluids or semi-solids. So the destruction in the region of the lake bed must have been caused by pressure waves. These waves originated locally, at the bottom of the sediment-filled basin, where about 30 percent of the energy from incoming shear waves would have been converted into pressure waves. Seismic data suggest the length of these pressure waves is 3 kilometres.

As the zones of maximum and minimum destruction were 750 metres apart, the observations fit the seismological prediction perfectly. Maximum collapses should be at the peak and trough of each wave, with minima at each end of the wave and at its central point, where displacement would have been at its lowest.

Researchers at the Instituto de Fisica in Mexico City now want to refine their model to determine more precisely the nature and direction of movement at every locality within the boundary of the lake. This should help engineers to ensure that new "earthquake proof" buildings stand up rather better than their predecessors did.

1. State which waves in the article are longitudinal and which are transverse, and explain why. [3 marks]
2. What was the resonant frequency of the tower blocks that proved most   
   vulnerable to the quake? [2 marks]

1. Determine the velocity of a traveling seismic wave in the sediment-filled basin.

[2 marks]

(d) Using the seismic data offered in the third paragraph, explain why, in the

fourth paragraph, the author is able to authoritatively assert that the

750 metre spacing of the maximum and minimum destructive zones 'fit the

seismological prediction perfectly'. [3 marks]

**End of Test**