Physics ATAR - Year 11

Waves
Unit Test
2016

Name:

Mark: / 57

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Time Allowed: 50 minutes

Notes to Students:

- You must include **all** working to be awarded full marks for a question.
- Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
- **No** graphics calculators are permitted – scientific calculators only.

Question 1 **(3 marks)**

The ear canal acts as a closed column of air 1.70 cm in length from the outer ear to the ear drum. Calculate the fundamental resonant frequency of the ear canal.

Question 2 **(5 marks)**

Students from the School are planning an entry for the World Robo Cup. One part of the competition requires the robots to play soccer. To 'see' the position of the 10.5 cm soccer ball used, each robot sends out a sonar signal.

(a) Calculate the lowest possible frequency of the sonar signal to 'see' the ball.

(3 marks)

(b) Explain what would happen if a frequency lower than that calculated in part (a) was used.

(2 marks)

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Question 3 **(3 marks)**

You are attend attending a concert night rehearsal and taking sound intensity measurements of Leo playing his saxophone. At the back of the concert hall 21.0 m from Leo you measure an intensity of 1.30×10^{-6} Wm^{-2}. Calculate the distance from Leo where the measurement would be 1.17×10^{-5} Wm^{-2}.

Question 4 **(10 marks)**

Before starting to rehearse Jack is tuning a string on his guitar using a 450 Hz tuning fork. He notices that as he gets closer he hears a pulsating loudness and softness of sound equivalent to 4.00 Hz.

(a) Determine the possible frequencies of his guitar string.

(2 marks)

(b) As he tightens the string he notices the pulsating sound increases in frequency. Which of the possible frequencies in part (a) was correct? Explain your reasoning.

(4 marks)

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(c) Later during the rehearsal Jack notices that when he plays a particular note on his base guitar the snare drum begins to vibrate. How would Jack, a competent physics student, explain this?

(4 marks)

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Question 5 **(9 marks)**

An instrument maker understands that he can use either a closed or an open pipe to produce a note of the same frequency.

(a) Calculate the ratio of the length of a closed pipe to an open pipe if they are to produce the same frequency.

(3 marks)

The instrument maker manufactures a 2.46 m pipe that can be used to create standing waves in either an open or closed mode by a pedal that opens or closes an aperture at the bottom of the pipe.

(b) Determine the frequencies of the first three harmonics of the pipe if it is left open at both ends.

(3 marks)

(c) Determine the frequencies of the first three harmonics of the pipe if it is closed at one end.

(3 marks)

Question 6 **(6 marks)**

Jeff is sitting on his surfboard in the ocean at Trigg Beach waiting to pick up a good wave to surf in on. While he is sitting in one position he starts to make some observations. He counts 30 waves passing beneath his board in a time of 3 minutes, with 9.0 metres between each crest and trough.

(a) Calculate the period of the water waves he has observed.

(3 marks)

(b) Calculate the wave speed of the waves observed.

(3 marks)

Question 7 **(7 marks)**

An alarm clock that incorporates a ringing bell and a flashing light is placed in a large sealed glass jar. An observer hears that the bell is ringing and sees that the light is flashing.

(a) Describe what an observer would notice when the air is totally removed from the jar by a vacuum pump.

(3 marks)

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(b) Explain the observations made in part (a).

(4 marks)

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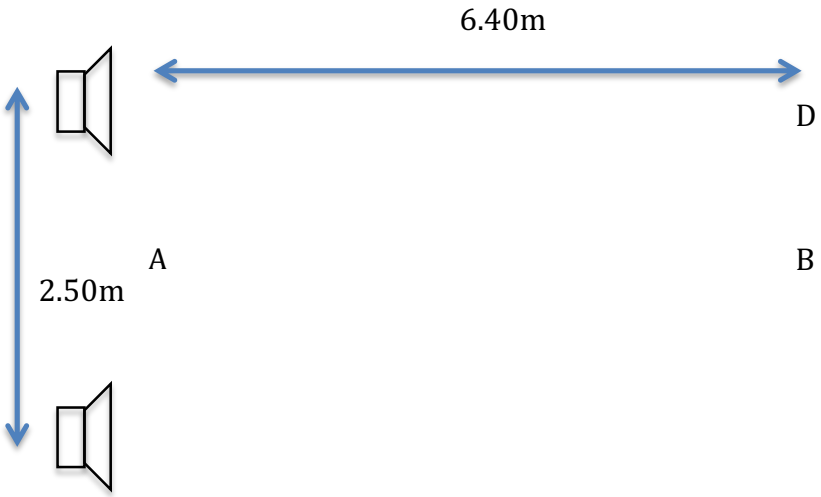
Question 8 **(7 marks)**

Two loud speakers as shown in the diagram below are connected in phase with both emitting sounds of 360 Hz. The speakers are 2.50 m apart on a day the speed of sound in air is measured at 340 ms^{-1}.



(a) Describe and explain what a student would hear when walking from point A towards point B along the midpoint between the two speakers.
(2 marks)

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(c) (i) Describe what a student would hear when walking from point B towards point D.
(2 marks)

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(ii) Explain what is happening to the sound waves between points B and point D.
(3 marks)

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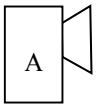
Question 9 **(7 marks)**

A loudspeaker produces a 500 Hz sound at point A and a listener is located at point B.



(a) Describe the motion of the particles in the air between points A and B.
(2 marks)

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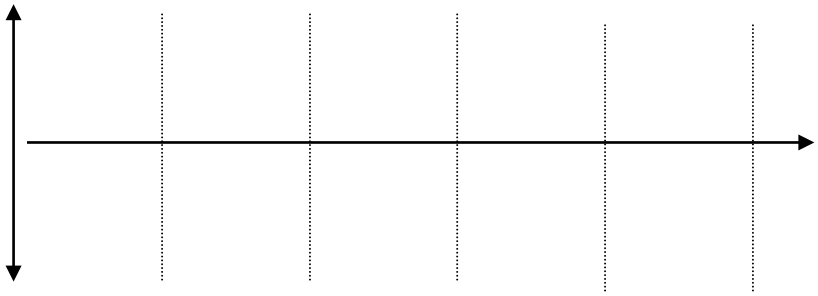
(b) **Sketch** an appropriate displacement v time graph for a particle experiencing the wave travelling between points A and B, labelling the axes and indicating units for two complete oscillations.
(3 marks)



(c) Indicate which of the following quantities can be established directly from your graph by labelling them on the sketch graph above.

wavelength – amplitude – period - frequency. Indicate them on your graph.
(2 marks)

End of Test