WILLETTON SENIOR HIGH SCHOOL

Year 11 Physics – 2018

Waves Test

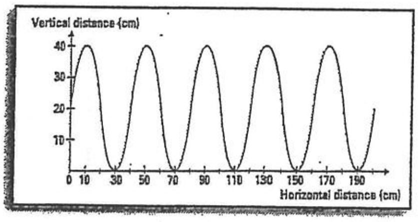
BRETT'S ANOTATED.

Student name:

MARKING KEY

Teacher ~~**(Please tick one box)**~~

	Group	
Mr Boughton	**1**	☐
Mr Dopson	**2**	☐
Mr Dopson	**3**	☐
Dr Pitts	**4**	☐



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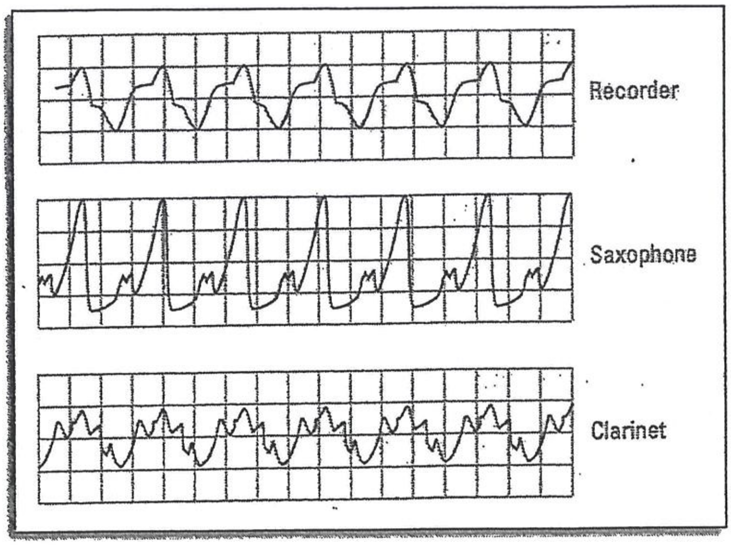
NOTE:

1. Calculations must show **clear working** with **formulae** and final answers stated to **three significant figures.**
2. Marks will be allocated for clear and logical setting out.
3. State your assumptions if working on open ended type questions.
4. Underline your answers.
5. Half a mark may be taken off for incorrect number of significant figures and incorrect units in the final answer.

1. The following waveforms are produced when different musical instruments are played in front of a microphone. Each instrument is played in the same place each time. The oscilloscope controls remain unchanged. There is no external interference.



a) Identify which instrument is producing the loudest sound and give a reason for your choice. (1)

Saxophone ½

Greatest amplitude ½

b) How can you tell that all instruments are producing a note of the same pitch? (1)

OR λ OR T SAME

The frequency of the three waveforms are the same

c) Why do all the notes have a different sound? Δ A = 0 MARKS (1)

The quality of the three waveforms are different. DIFF WAVE SHAPE ½

or different harmonics or overtones

2. Name the property of sound waves associated with each of the following:

a) An opera singer breaking a glass by singing. (1)

Resonance

b) Hearing around corners. (1)

Diffraction

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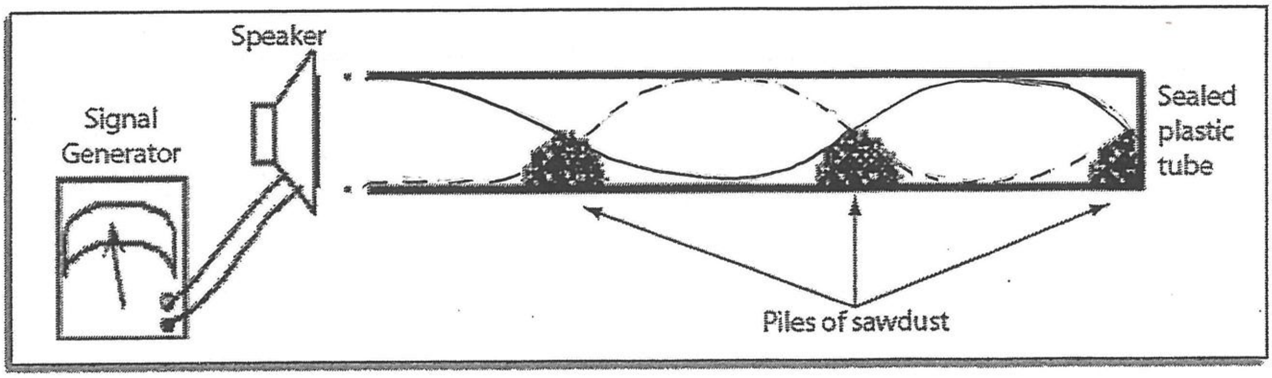
3. State the two conditions necessary to hear beats. 2 DIFF f = (½) ONLY (2)

- The two frequencies must be close
- Amplitudes must be similar or same

4. A speaker from a signal generator is attached to one end of a plastic tube that contains sawdust. Before the signal generator is switched on, the sawdust is distributed evenly over the length of the tube. When the signal generator is switched on, the frequency is adjusted, and resonance is heard. The sawdust gathered into three piles as shown in the diagram below.

5°



a) On the diagram above, draw the standing wave pattern in the tube at this frequency. (1)

b) If the tube is 1.80 m long, what is the frequency of the signal generator? (2)

$$f_n = \frac{nV}{4L} = \frac{5 \times 346}{4 \times 1.80} = \frac{1730}{7.2} = 240.28\ Hz$$
(½) (½)
$$= 240\ Hz$$ (1)

c) What is the fundamental frequency of this tube? (2)

$$f_1 = \frac{f_5}{5} = \frac{240.28}{5} = 48.056$$
(½) (½)
$$= 48.1\ Hz$$ (1)

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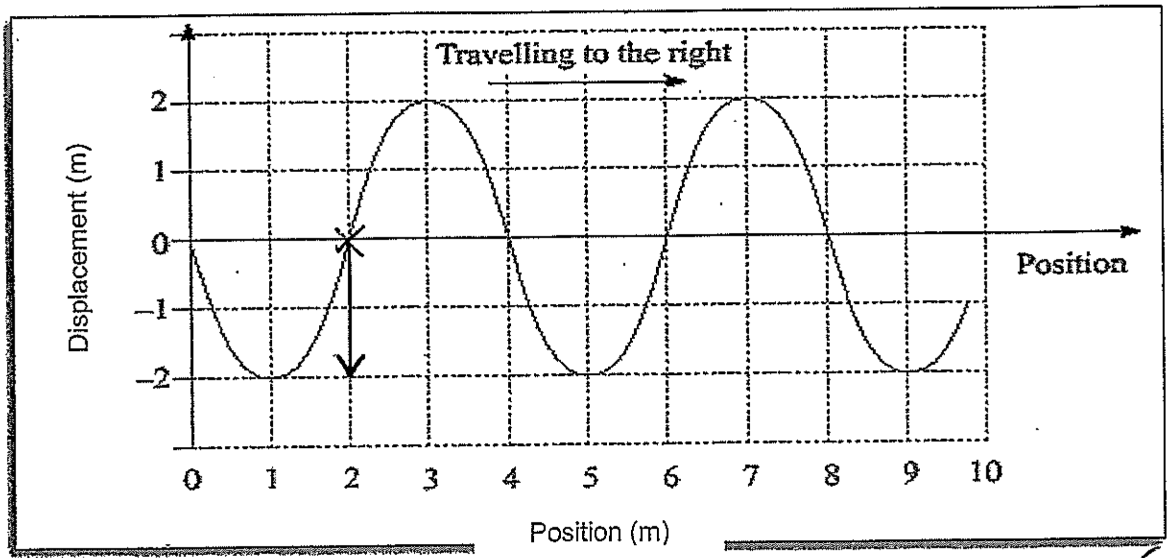
5. A water wave, shown in the diagram below, is travelling to the right. It has a speed of 10.0 ms^{-1}.



(1 s.f. ok)

a) What is the amplitude of the wave? 2 m (1)

b) What is the wavelength of the wave? 4 m (1)

c) Calculate the frequency of the wave. (2)

$V = f\lambda$

$\therefore f = \frac{V}{\lambda}$

$= \frac{10.0}{4}$

$= 2.50\ Hz$

(−1 if $v = 346\,ms^{-1}$
– no penalty if λ is incorrect)

d) Calculate the period of the wave. (1)

$T = \frac{1}{f} = \frac{1}{2.50} = 0.4\ s$ (1 s.f. ok)

e) Using an arrow on the diagram above, clearly show the direction of movement of the water's surface at the 2 m position. (1)

(see above)

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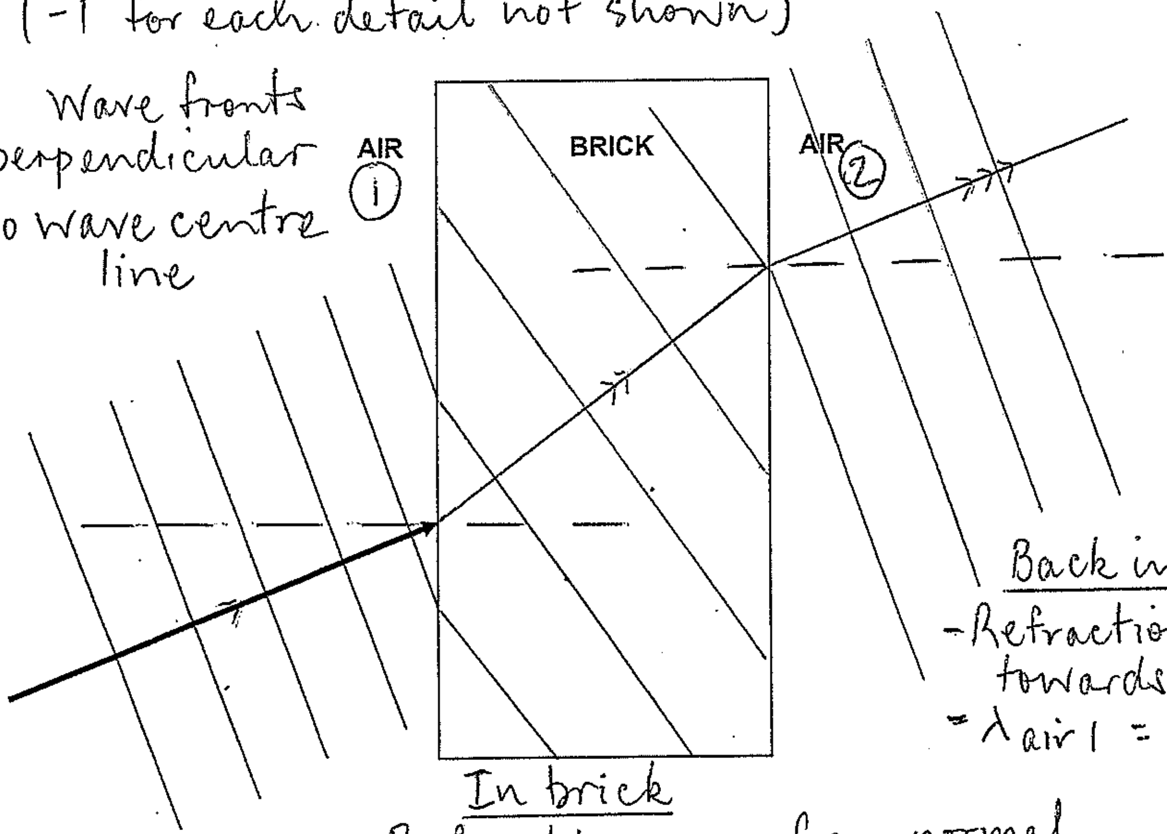
6. A sound wave passes through a thick brick wall as shown below.

a) Complete the diagram showing the path of the sound through the brick and out the other side. Show the wave fronts. (4)

(-1 for each detail not shown)

Wave fronts perpendicular to wave centre line



Back into air
- Refraction towards normal
- $\lambda_{air\,1} = \lambda_{air\,2}$

In brick
- Refraction away from normal
- λ increases

b) State what happens to the frequency, velocity and wavelength of the sound wave above by using the words ***increases***, ***decreases*** or ***remains the same*** as the sound wave passes from **air** into the **brick**. (3)

Frequency Remains the same

Velocity Increases

Wavelength Increases

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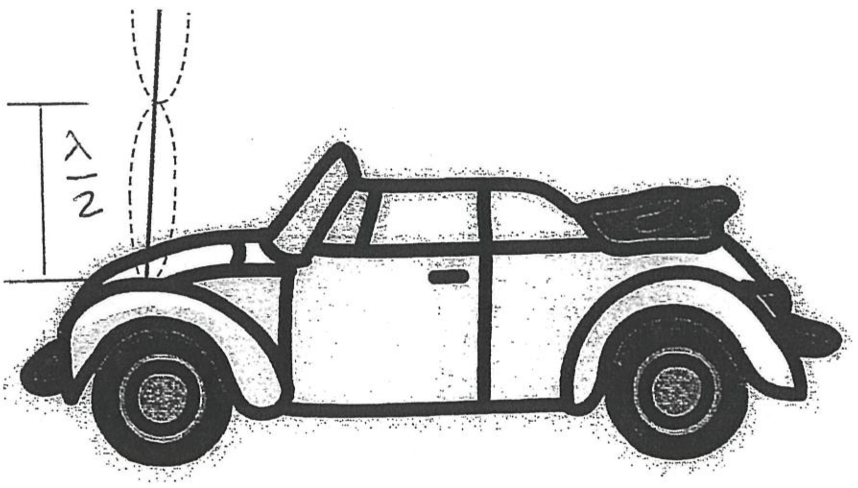
7. A stationary car is observed at a set of traffic lights with its engine running. On the front of the car, the radio antenna is observed to be vibrating as shown in the diagram:



a) If the radio antenna is 1.25 m long, calculate the wavelength of the standing wave. (2)

$L = \frac{3\lambda}{4}$ (½)

$\therefore \lambda = \frac{4}{3} \times L = \frac{4 \times 1.25}{3}$ (½) $= 1.667$ m

or 1.67 m (1) (3s.f.)

b) The car's engine idles at 500 rpm. Assuming that the radio antenna experiences 500 vibrations per minute, calculate the speed of the wave in the antenna. (2)

$f = \frac{500}{60}$

$= 8.33$ Hz (1)

now $v = f\lambda$ (½) only

$= 8.33 \times 1.667$

$= 13.89$ ms^{-1}

$= 13.9$ ms^{-1} (1) (3s.f.)

c) Explain how you could adjust the antenna to stop the tip (end) from vibrating? (2) (1)

- Lower the antenna to $\frac{\lambda}{2} = \frac{1.67}{2} = 0.835$ m
- Extend or retract the antenna
- Place a mass at the top
- CHANGE ENGINE RPM

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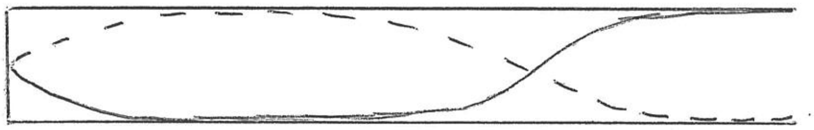
8. A **closed pipe** is 50.0 cm long and is made to vibrate at its **first overtone**.

a) Draw a representation of the first overtone below. (1)

closed pipe 1°, 3°, 5°, ...
first overtone



b) Calculate the frequency of the wave. (2)

$$f_n = \frac{nV}{4L} = \frac{3 \times 346}{4 \times 0.50} = \frac{1038}{2} = \underline{519\ Hz}$$ (1)

$(\tfrac{1}{2})$ $(\tfrac{1}{2})$

(-1 if incorrect harmonic used)

9. Define resonance and state one example. (3)

Definition: oscillation induced in a physical system when it is affected by another system that is itself oscillating at the right natural frequency, with an increase in amplitude

Example: Playing a wind or string musical instrument

Tacoma Bridge

Singer breaking a glass (Any reasonable answer

10.

a) Describe the relationship between sound intensity and distance. (1)

Sound intensity is proportional to the inverse square of the distance. (1)

$I \propto \frac{1}{d^2}$ $(\tfrac{1}{2})$ if formula only given

b) If your ear experiences 1.80×10^{-12} Wm^{-2} of sound when you are 1.00 m from a sound source, what will be the theoretical new sound intensity experienced by your ear when you are standing 8.00 m from the same sound source? (2)

$$I = \frac{1.80 \times 10^{-12}}{8^2} = \underline{2.81 \times 10^{-14}\ Wm^{-2}}$$ (1)

(1)

End of Test

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