YR11 Physics

WILLETTON SENIOR HIGH SCHOOL

/37✓ marks

WAVES TEST – 2017

Student. name: MASTER

Teacher (Please tick one box)

Mr Boughton ☐

Mr Dopson ☐ Group 1
☐ Group 2

Dr Pitts ☐ Group 3
☐ Group 4

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 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. Name the properties of sound waves which is associated with each of the following phenomenon:

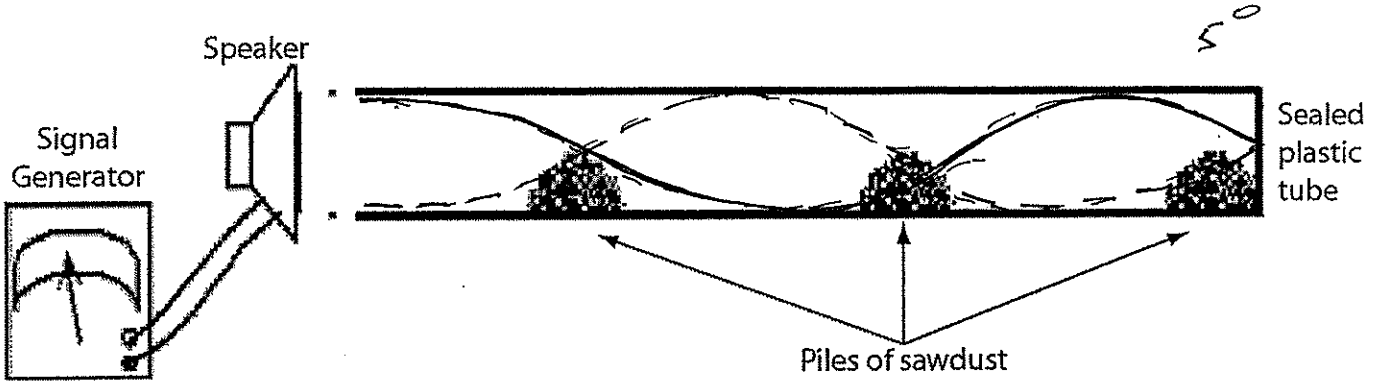
   a) An opera singer breaking a glass by singing. RESONANCE (1)

   b) Hearing around corners. DIFFRACTION (1)

2. State the two conditions necessary to hear beats.

   - THE TWO FREQUENCIES MUST BE CLOSE (1)
   - AMPLITUDES MUST BE SIMILAR OR SAME. (1)
   - CONSTRUCTIVE / DEST. INTERFERENCE IS ASSUMED AND DOES NOT IN ITSELF PRODUCE BEATS. = 0 MARKS

3. (5 marks) 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 and the frequency is adjusted and resonance is heard, the sawdust gathered into three piles as shown in the diagram.



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

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

$f_n = \frac{nV}{4L}$ (½) $= \frac{5 \times 346}{4 \times 1}$ (½) $= \frac{1730}{4} = 432.5$

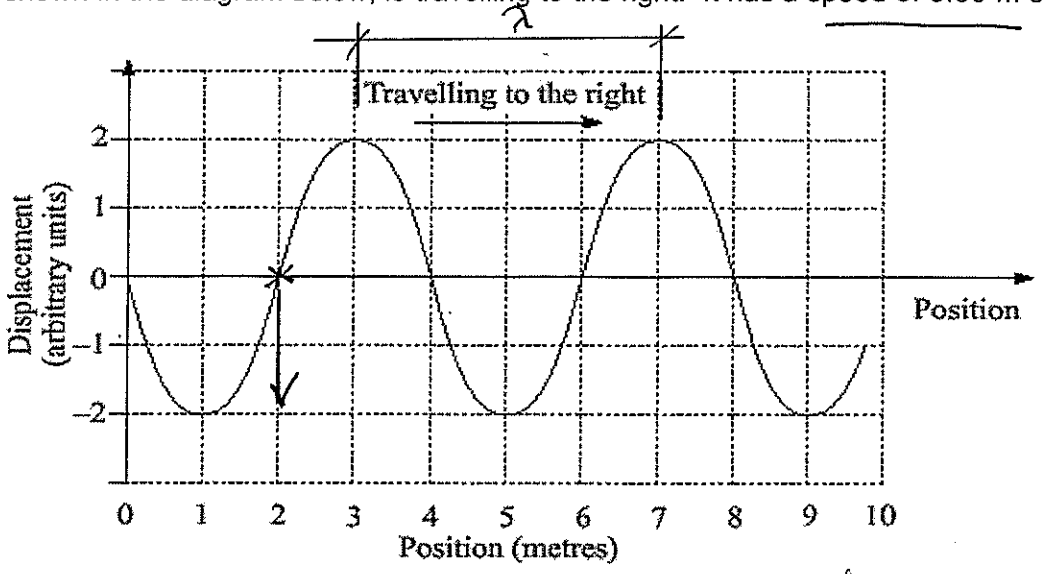
$= 433\ Hz$ (1)

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

$f_1 = \frac{f_5}{5}$ (½) $= \frac{432.5}{5}$ (½) $= 86.5 = \frac{87.0\ Hz}{(1)}$

9

4. (6 marks)
A water wave, shown in the diagram below, is travelling to the right. It has a speed of 5.00 m s^{-1}.



a) What is the amplitude of the wave? 2m (1) 1 s.f. O.K.

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

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

$v = f\lambda$

$\therefore f = \frac{v}{\lambda}$ (½)

$= \frac{5.00}{4}$ (½)

$= 1.25\ Hz$

(1)

(−1) IF $v = 346\ ms^{-1}$ − NO PENALTY IF λ IS INCORRECT.

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

$T = \frac{1}{f} = \frac{1}{1.25} = 0.800$ (½)

$= 0.8\ s$ (½)

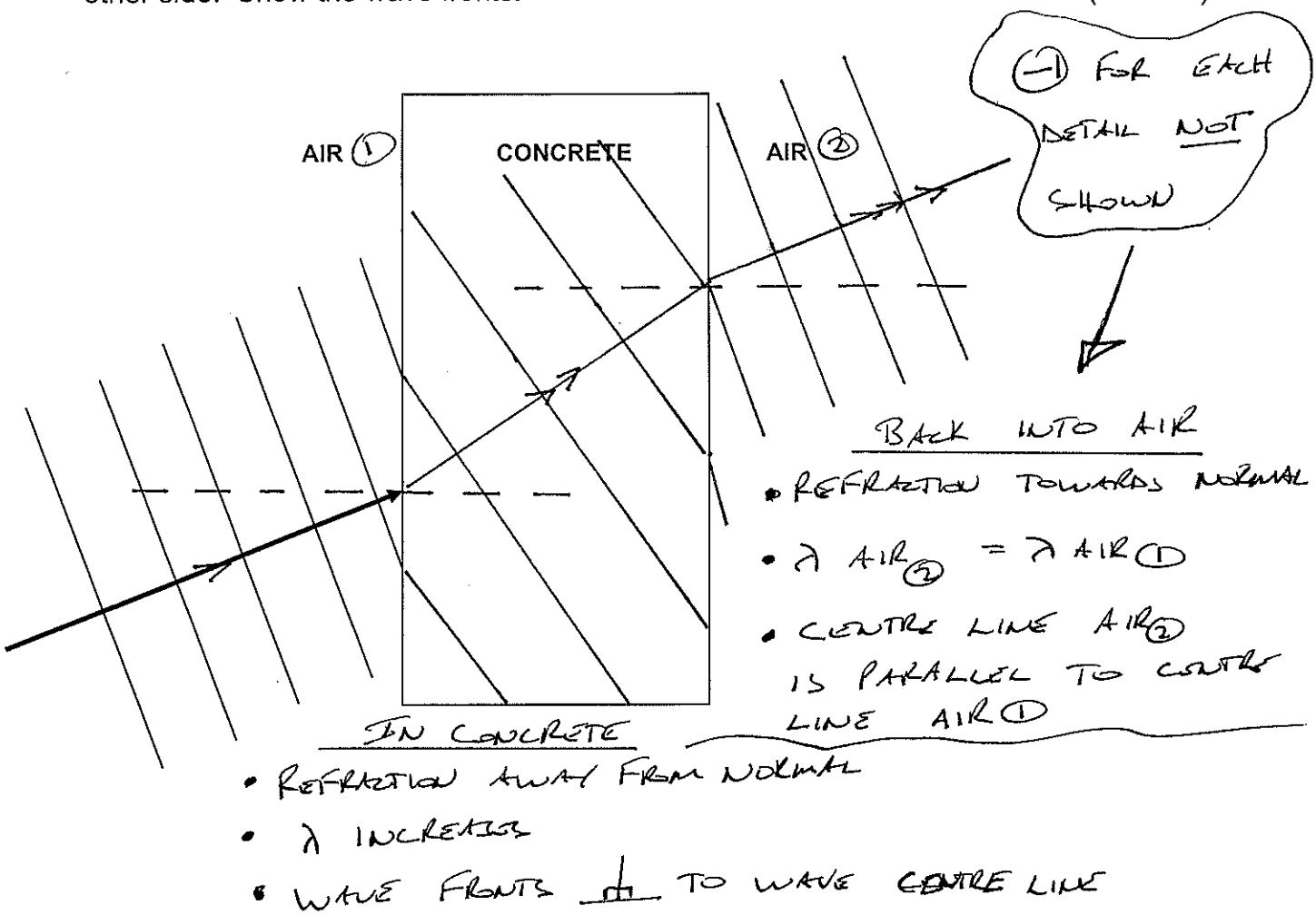
1 s.f. ONLY IS OK

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

SEE ABOVE.

5. (7 marks)
A sound wave passes through a thick concrete wall as shown below.

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



b) State what happens to the velocity, frequency 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 **concrete**.

(3 marks)

Velocity INCREASES (1)

Frequency REMAINS THE SAME (1)

Wavelength INCREASES (1)

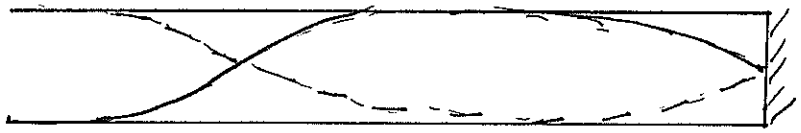
7

6. (3 marks)

a) A **closed pipe** is 50.0 cm long and is made to vibrate at its **first overtone**. Draw a representation of the first overtone harmonic below. (1)

CLOSED 1°, 3°, 5°, 7°

↑ FIRST OVERTONE



1½ STAGES!

-1 IF INC. HARMONIC.

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

$f_n = \frac{nV}{4L} = \frac{3 \times 346}{4 \times 0.5} = \frac{1038}{2} = 519 Hz$

(½) (½) (1)

RESONANCE OCCURS WHEN THE DRIVING FREQUENCY OR MULTIPLES OF THE DRIVING FREQUENCY COINCIDES WITH THE NATURAL FREQUENCY (1)

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

Definition: OF A COLUMN OF GAS OR STRUCTURE, WHICH RESULTS IN AN INCREASE IN THE GAS OR STRUCTURES AMPLITUDE OF VIBRATION (1)

Example: • PLAYING A WIND OR STRING MUSICAL INSTRUMENT. (1)
• TACOMA NARROWS BRIDGE
• SINGER BREAKING A GLASS ETC.

ANY REAL ANSWER.

8. (3 marks)

a) What is the relationship between sound intensity and distance? (1)

THE INTENSITY IS PROPORTIONAL TO THE INVERSE SQUARE (1) OF THE DISTANCE.

$I \propto \frac{1}{d^2}$ (½) ONLY IF ONLY EQN. SHOWN.

b) If your ear experiences 1.20×10^{-12} Wm^{-2} of sound when you are 1.00m from a sound source, what will be the theoretical new sound intensity experienced by your ear when you are standing 4.00m from the same sound source? (2)

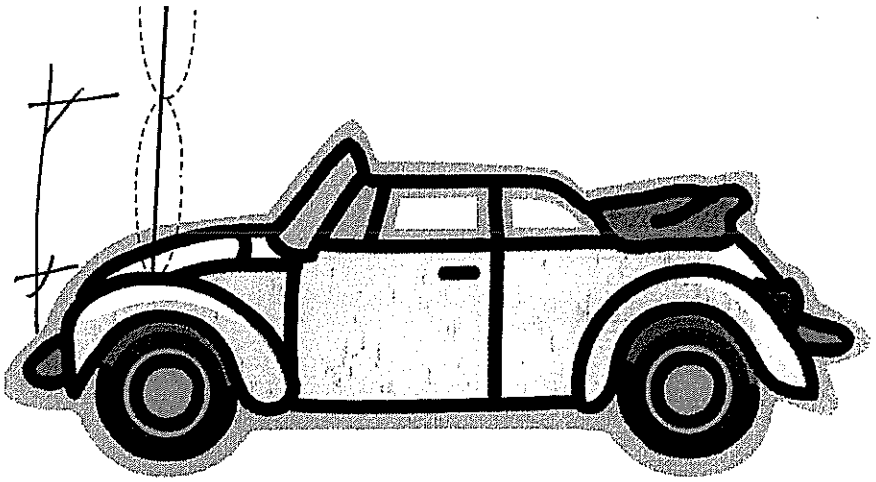
$I = \frac{1.20 \times 10^{-12}}{4^2} = 7.50 \times 10^{-14} Wm^{-2}$

(1) (1)

/9

8. (6 marks)

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:



$\frac{\lambda}{2}$

(a) If the radio antenna is 0.800m long, calculate the wavelength of the standing wave. (2)

$L = \frac{3\lambda}{4}$

$\therefore \lambda = \frac{4}{3} \times \frac{L}{1} = \frac{4 \times 0.8}{3} = 1.066'\text{m}$

OR 1.07m ✓

(b) The car's engine idles at 1000 rpm. Assuming that the radio antenna experiences 1000 vibrations per minute, calculate the speed of the wave in the antenna. (2)

WATCH - C.O

$f = \frac{1000}{60}$

$= 16.66'\text{Hz}$ (1)

NOW $v = f\lambda$

$= 16.666 \times 1.0666$

$= 17.77$

$= 17.8\text{ms}^{-1}$ (1)

(c) What could you do to the antenna to stop the **tip** (end) from vibrating? (2)

LOWER THE ANTENNA TO $\frac{\lambda}{2} = \frac{1.066}{2} = 0.533\text{m}$ (2)

- LOWER OR LENGTHEN ANTENNA (1) ONLY.
- BOLT ON A MASS (1) ONLY.
- CHANGE MASS DISTRIBUTION - (1) ONLY.
- CHANGE DIAMETER OR WALL THICKNESS (1) ONLY.

End of Test

/6

Name: – MASTER – BB – 2017 **Total:** /11

Question 1

Is acceleration downslope independent of mass?

Small glider

Given

t_u = 0.13 s

t_v = 0.04 s

t between = 1.97 s

Calculations

$u = \frac{0.05}{0.13} = 0.3846\ ms^{-1}$ (1)

$v = \frac{0.05}{0.04} = 1.25\ ms^{-1}$ (1)

$a = \frac{1.25 - 0.3846}{1.97} = 0.4392\ ms^{-2}$ (1)

(3) MARKS IF $a_{SMALL} \approx 0.4\ ms^{-2}$ (3)

More massive glider

Given

t_u = 0.13 s

t_v = 0.04 s

t between photogates = 1.97 s

Calculations

$u = \frac{0.05}{0.13} = 0.3846\ ms^{-1}$ (1)

$v = \frac{0.05}{0.04} = 1.25\ ms^{-1}$ (1)

$a = \frac{1.25 - 0.3846}{1.97} = 0.4392\ ms^{-2}$ (1)

(3) MARKS IF $a_{BIG} \approx 0.4\ ms^{-2}$ (3)

Answer: (1) YES, ACCELERATION IS INDEPENDENT OF MASS i.e. $a_{SMALL} \approx a_{BIG}$ (1)

Question 2

Calculate the theoretical acceleration downslope and then determine the % difference between the theoretical acceleration downslope and the experimental acceleration downslope for the small glider.

(4)

FOR θ

$\tan\theta = \frac{66}{1500}$

$\therefore \theta = 2.519^\circ$

$\approx 2.5^\circ$

[ACCEPT 2 TO 3°] (1)

FOR (a_{THEOR})

$a_{TH} = g \sin\theta$

$= 9.80 \times \sin 2.519^\circ$

$= 0.43071\ ms^{-2}$

$= 0.43$

CORRECT METHOD (1)

FOR % DIFF

GIVEN

$a_{EXP-SMALL} = 0.4392 ms^{-2}$

CORRECT METHOD (1)

$$\%\ DIFF = \frac{THEOR - EXP}{THEOR} \times \frac{100}{1}$$

$$= \frac{0.4392 - 0.4307}{0.4307} \times \frac{100}{1}$$

$\approx 2\%$ [ACCEPT 1 TO 4%] (1)