Year 12 Physics
2011

Wave Phenomena
Unit Test

Name:	Mark: / 50 = %

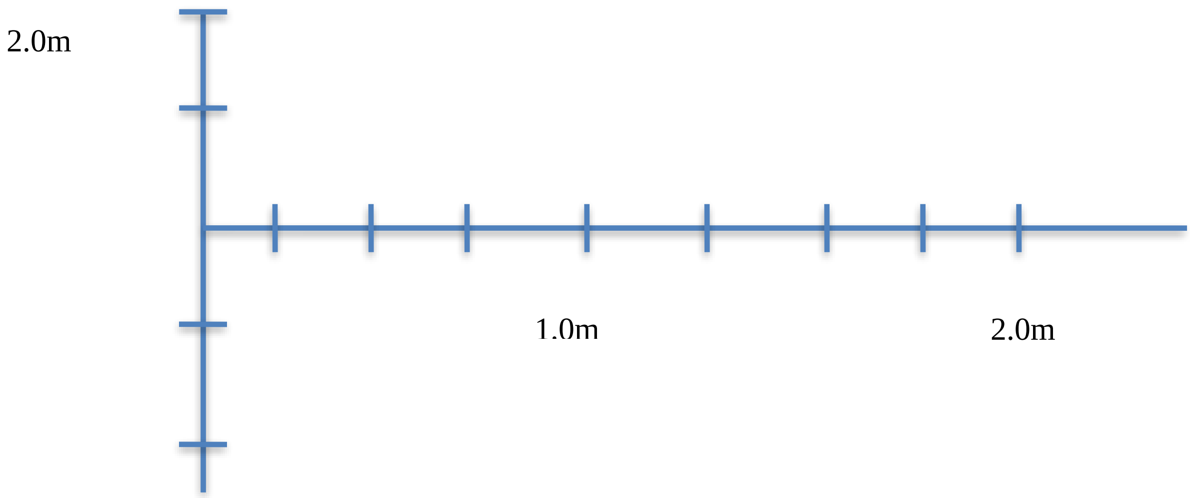
Notes to Students:

You must include **all** working to be awarded full marks for a question.

Marks will be deducted for incorrect or absent units.

Marks will be deducted for incorrect numbers of significant figures.

1. a) On the axis below draw two complete waves of amplitude 2.00m and wavelength of 1.00 m.



[2]

b) If the speed of the wave is 420 ms^{-1} Calculate the frequency of the wave.

$V = f \times \lambda$

$420 = f\ (1.00)$

$f = 420$ Hz

[2]

c) What is the period of the wave?

$T = 1/f$

$= 1/420$

$= 2.38 \times 10^{-3}$ s

[2]

2. A small moth of size 0.80cm is flying in front of a bat. What is the lowest frequency that the bat needs to emit to be able to see the moth?

$V = f \times \lambda$

$346 = f \times 0.8 \times 10^{-2}$

f = 43250 Hz

[3]

3. a) The pilot of a twin engine Cessna has one engine running at 3100rpm notices that the engines are making a throbbing sound with a frequency of 5 Hz. What is he experiencing and how can you explain this phenomena.

He is experiencing beats where the frequency difference of the two engines is 5 Hz

Beat $f = | f_2 - f_1 |$

The two waves of slightly different frequencies travelling through the same medium add together constructively and destructively creating loud and soft sounds that have a regular frequency as they move in and out of phase

[2]

b) If the pilot increases the revs slightly of the other engine he notices that the throbbing is more frequent. What are the revs of the second engine.

3100 rpm = 51.6 Hz

second engine is running at 46.6 Hz or 56.6 Hz to give 5 Hz beats

as the second engine increases beat F increases implying getting further away hence second engine is running at 56.6 Hz = 3396 rpm

[3]

4. A brass tube stands vertically in a tall jar of water so that it's top is level with the water surface. The tube is raised vertically and a continuously vibrating tuning fork is held above the open end. A second resonance point is heard when the tube is raised 0.293 m from the position of the first point of resonance. If the speed of sound in air is 346ms^{-1}, find the frequency of the tuning fork.

Closed pipe – difference in length for consecutive points of resonance is 0.5 λ

Wavelength is then 2 (0.293) m = 0.586 m

$V = f \times \lambda$

$346 = f\ (0.586)$

$f = 590$ Hz

[3]

5. You are waiting on the terminating road at a 'T' junction giving way to an ambulance which is travelling towards you and then continues past you on it's way with sirens sounding.

a) What do you notice about the siren through it's journey?

As the ambulance approaches the siren sounds at a higher pitch than normal, when level with you it sounds normal and as it leaves you the pitch is heard to decrease.

[2]

b) What is the name of this phenomena?

Doppler effect.

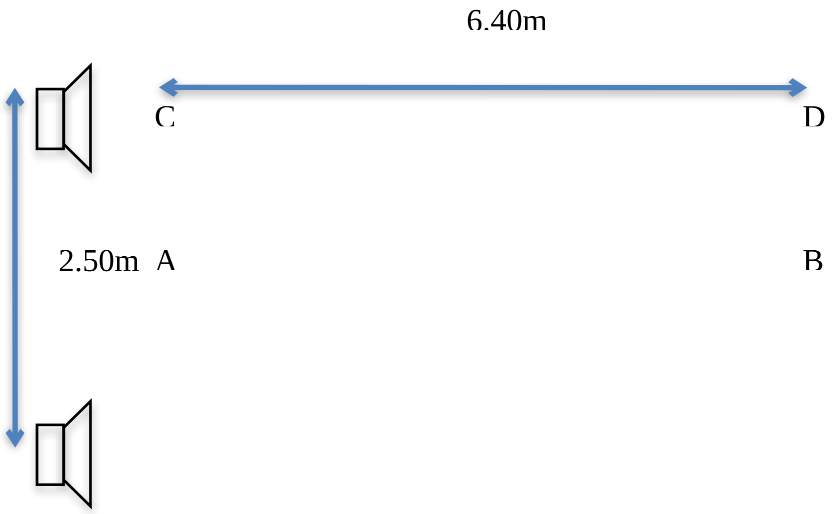
[2]

c) Explain what causes this change in sound that is heard as the ambulance moves.

As the ambulance moves towards you the peaks of the sound waves are being compressed due to the movement of the ambulance, this reduces their wavelength as the sound you hear is higher pitched. As the ambulance leaves you the peaks of the wave are spreading out and their wavelength is increasing causing their pitch to be lower. The faster the movement the greater the effect.

[3]

6. Two load speakers are connected in phase and are both emitting sounds of 360 Hz. If the speakers are 2.50 m apart assuming the speed of sound is 346 ms^{-1}



a) find the wavelength of the wave?

$V = f \times \lambda$

$346 = (360)\ \lambda$

$\lambda = 0.96$ m

[2]

b) Describe what the person would hear if they walked from A to B.

As you walked from A to B you would always be equidistant from both speakers. As the speakers are in phase the wave meeting you along AB would also be in phase and constructive interference would occur allowing you to hear a loud note of 360 Hz. The sound would however decrease as you moved further away from the speakers.

[3]

c) Describe what the person would hear if they walked from C to D.

As you walk from C to D the distance from each speaker is different and this means that the path difference of the two sound waves is changing. At some points you will hear a loud sound when, both waves are in phase and at other points they would be out of phase and you would hear a soft sound or experience a null point

[3]

d) If the person started walking from just in front of the speaker on the line CD a distance of 6.40 m what would they hear?

Path distance from C = 6.40 m

(Path distance from lower speaker)^2 = $(2.5)^2 + (6.40)^2$ = 6.88m

difference = 0.48m which is ½ λ

hence the waves arrive out of phase and the person would hear a soft or null

[3]

7. The latest trend in radio controlled models is using 2.4 GHz transmitters as this band allows multiple users with minimal interference. Calculate the wavelength that these transmitters would use as a carrier wave.

$V = f \times \lambda$

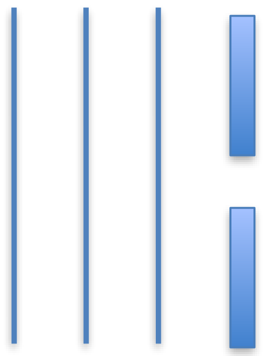
$3 \times 10^8 = (2.4 \times 10^9)\ \lambda$

$\lambda = 0.125$ m

[3]

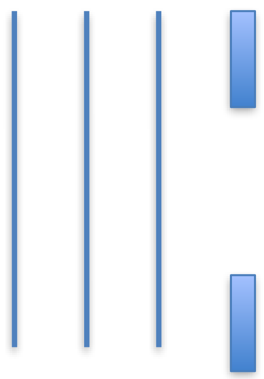
8. Complete the following diagrams indicating the transmitted wave.

a)



[2]

b)



[2]

9. Define the following

a) Forced vibration

a system will oscillate on its own if it has an external force applied to it

[2]

b) natural frequency

when an object vibrates at the frequency that it want to vibrate at

[1]

c) resonance

when the forced vibration matches the natural frequency of the object resulting in an increase in amplitude due to constructive reinforcement

[2]

10. An open pipe will need to be how long for the air column in the pipe to resonate at its 3rd harmonic if the vibrating source is 250 Hz?

Open pipe length for fundamental is ½ λ

Third harmonic would need 1 ½ λ

$V = f \times \lambda$

$346 = 250 \times \lambda$

$\lambda = 1.384$ m

third harmonic then = 1.5 (1.384) = 2.076 m

[3]