Unit 9 · Acoustic Phenomena

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

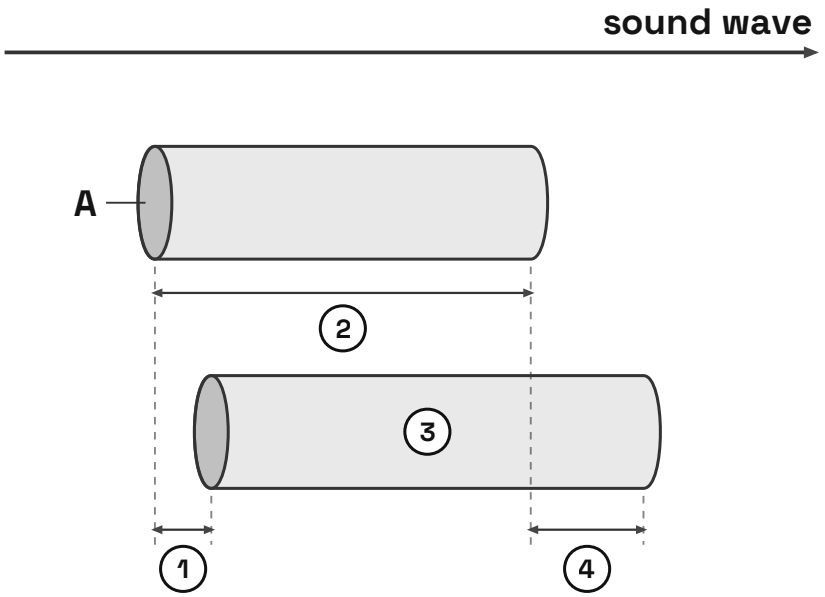
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

Doppler's effect	**intensity**	**loudness**	**Mach number**	**overtone**	**pitch**
pressure amplitude	**quality**	**ultrasonic**	**wavelength**		

The greatest rise or fall of pressure from its normal value as a sound passes is the _____. The average rate at which sound energy flows through unit area normal to the wave is its _____. How strong a sound seems to a listener is its _____, and how high or low it sounds is its _____. Sounds above 20 kHz are _____. The characteristic that lets us tell apart two sounds of the same pitch and loudness from different instruments is their _____. The change in the frequency received because the source and the listener move relative to each other is _____. An object's speed divided by the speed of sound is its _____.

2 Label the diagram [2]

The diagram shows a thin cylinder of air along the path of a sound wave, before and after the wave displaces its ends. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A sound has an intensity of $1.0 \times 10^{-6}\ \text{W/m}^2$. Taking the threshold of hearing as $10^{-12}\ \text{W/m}^2$, its intensity level is: [1]

a. 6 dB **b.** 60 dB
c. 106 dB **d.** 120 dB

ii. You walk from 3 m to 9 m away from a loudspeaker in the open. The intensity level falls by about: [1]

a. 3 dB **b.** 6 dB
c. 9.5 dB **d.** 19 dB

iii. The displacement amplitude of a sound is doubled at the same frequency. Its intensity becomes: [1]

a. twice as large **b.** four times as large
c. half as large **d.** the same

iv. A jet flies at Mach 1.5. The half-angle of its Mach cone is about: [1]

a. 30° **b.** 42°
c. 56° **d.** 67°

v. A listener runs towards a whistle that is at rest. The sound waves reaching her have: [1]

a. the same wavelength, but pass her more often
b. a shorter wavelength
c. a longer wavelength
d. a greater speed in the air

4 Short answers [7]

Write short answers to the following questions.

a. Write any two differences between the intensity and the loudness of a sound. [2]

b. Why does the note of an ambulance's siren drop suddenly as the ambulance passes you? [2]

c. An ambulance's siren sounds at 700 Hz, and the ambulance drives at 25 m/s past a person standing by the road. Find the frequency she hears as it comes towards her and as it goes away. (Speed of sound = 340 m/s.) **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

A source of frequency f moves with speed v_s towards a listener at rest. Derive the frequency she hears, and write how the result changes when the source moves away from her.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take the threshold of hearing as 10^{-12} W/m^2.

a. A 1000 Hz sound in air (density 1.2 kg/m^3, speed 340 m/s) has a pressure amplitude of 0.20 Pa. Find i. its intensity, ii. its intensity level, iii. the displacement amplitude of the air, and iv. the intensity level four times as far from the source, in the open. **[4]**

Answer:

b. A car drives at 15 m/s towards a tall wall, sounding its 450 Hz horn. The speed of sound is 340 m/s. Find i. the frequency a person standing at the wall hears, ii. the frequency of the echo the driver hears, and iii. the echo's frequency if the car drove away from the wall at the same speed. **[4]**

Answer: _____

7 Think [3]

A car passes along a straight road, its horn sounding steadily, and you stand a little way from the road. At the moment the car is closest to you, the frequency you hear is the horn's real frequency. Why?

8 Activity: Measure the inverse square law (not marked)

Use a sound meter app on a phone and a small speaker playing a steady tone, out in an open space. Read the level at 1 m, 2 m and 4 m from the speaker.

Distance (m)	Level (dB)	Change from the last (dB)
1		–
2		
4		

By how much did the level fall each time the distance doubled?