## SI Physics - Full Discipline Demo

#### Resonance

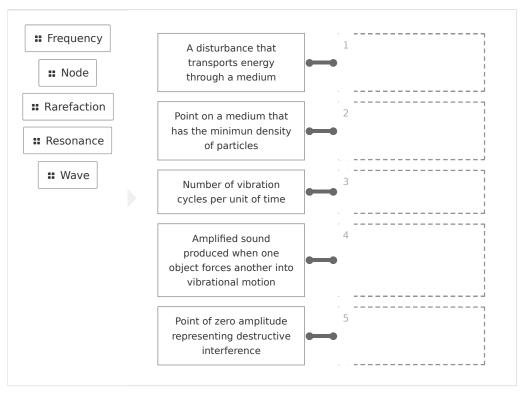
### Final Report - Answer Guide

InstitutionScience Interactive UniversitySessionSI Physics - Full Discipline DemoCourseSI Physics - Full Discipline Demo

**Instructor** Sales SI Demo

### Test Your Knowledge

#### Match each term with the best description.

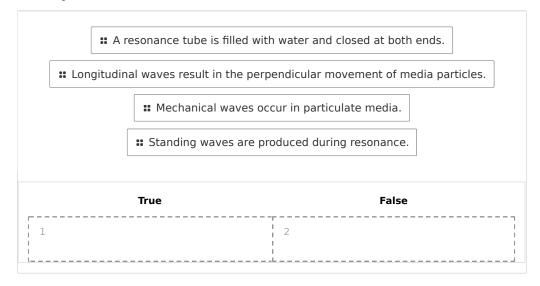


#### Correct answers:

1 Wave 2 Rarefaction 3 Frequency 4 Resonance 5 Node



#### Identify each statement as true or false.



#### Correct answers:

1 Standing waves are produced during resonance.

Mechanical waves occur in particulate media.

2

Longitudinal waves result in the perpendicular movement of media particles.

A resonance tube is filled with water and closed at both ends.

## **Exploration**

Mechanical waves are produced in media composed of particles and include

	ocean waves	
	seismic waves	
	sound waves	
	All of the above	<b>~</b>



The velocity of a mechanical wave is the prod	uct of its wavelength and
<ul><li>compression</li></ul>	
frequency	<b>~</b>
<ul><li>rarefaction</li></ul>	
All of the above	
Resonance only occurs in air, but not liquid or	r solid media.
○ True	
○ False	<b>~</b>
A(n) is produced at the water surface as resonance tube.  antinode  node  transverse wave  All of the above	sound travels inside a ✓
rcise $oldsymbol{1}$ ain how sound is amplified by a resonance tube.	
in non sound is unipinied by a resonance tuber	
nd is produced in a resonance tube when an antinode above the opening in the tube. The standing waves a ne same frequency as the tuning fork held near the op	re the result of the air column vibrating

fork into the air column until reaching the water. The waves are then reflected and encounter waves traveling in the opposite direction, creating standing waves.

The speed of sound in air is influenced by temperature and can be estimated using the equation:  $v = 331.4 \text{ m/s} + 0.6(T_c)$ . Calculate the theoretical speed of sound at your experimental air temperature using this equation. How does this value compare to the speed of sound recorded in Data Table 2? Explain possible sources of error in your results.  $V = 331.4 \text{ m/s} + 0.6(20.0 \,^{\circ}\text{C})$  $V = 343.4 \text{ m/s} @ 20 ^{\circ}\text{C}$  compared to experimental results of 347 m/s. Possible sources of error include: Incorrectly identifying the length of tube where the loudest resonance was produced • Measurement error of the air column diameter when using the ruler Measurement error of ambient temperature when using the thermometer Tuning fork variance between the printed frequency and emitted frequency The resonance tube used in this experiment produced only one resonance tone. What length of tube would be required to produce a second tone under the same experimental conditions? Explain your answer. 0.68 m In long tubes, resonance tones occur at  $\lambda/4$ ,  $3\lambda/4$ , and  $5\lambda/4$  intervals respectively. The wavelength recorded in the experiment was 0.9028 m. The second resonant tone would be produced at  $3\lambda/4 = 3(0.9028 \text{ m})/4 = 0.6771$ m and would require a tube of at least that length. How would your calculations for the wavelength and speed of sound recorded in Data Table 2 vary if a 512 Hz tuning fork were used? Explain your answer. The measured wavelength would decrease, but the speed of sound would remain constant. The



speed of sound in air is constant for all frequencies. Using the theoretical speed of sound for 20

°C, the wavelength is determined as:  $\lambda = v/f = (343.4 \text{ m/s}) / 512 \text{ Hz} = 0.671 \text{ m}.$ 

# Data Table 1: Experimental Conditions (SAMPLE ANSWER BELOW)

Temperature (°C)	Diameter (m)	Frequency (Hz)
20.0	0.019	384

# Data Table 2: Resonance Wavelength and Velocity (SAMPLE ANSWER BELOW)

Trial	Length (m)	Mean Length (m)	$\lambda = 4(L+0.3d) (m)$	$v = f\lambda (m/s)$
1	0.220			
2	0.218	0.220	0.903	347
3	0.222			

## **Competency Review**

Mechanical waves travel by interacting with particles within the medium	n.
○ True	<b>✓</b>
False	
Longitudinal waves propagate in	
<pre>air</pre>	
<ul><li>liquids</li></ul>	
<ul><li>solid media</li></ul>	
All of the above	<b>~</b>
Longitudinal waves are characterized by regions of compression and rarefaction.	
○ True	<b>~</b>
• False	



compression to the next compression.	
frequency	
<ul><li>wavelength</li></ul>	<b>✓</b>
<ul><li>velocity</li></ul>	
<ul> <li>All of the above</li> </ul>	
waves are produced when waves of i	dentical frequencies traveling in
<ul><li>Longitudinal</li></ul>	
Standing	<b>✓</b>
<ul><li>Transverse</li></ul>	
<ul> <li>All of the above</li> </ul>	
A resonance tube is used to measure resor	nant frequencies occurring in
A resonance tube is used to measure resor  air plastic water	nant frequencies occurring in
A resonance tube is used to measure resor  air plastic water All of the above	
A resonance tube is used to measure resor  air plastic water	
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A resonance tube is used to measure resor  air  plastic  water  All of the above  A resonance tube emits a tone when the the opening of the tube.	of a standing wave occurs at
A resonance tube is used to measure resor  air  plastic  water  All of the above  A resonance tube emits a tone when the the opening of the tube.  antinode	of a standing wave occurs at



The	should be measured when using a resonance tube.	
o ar	mbient temperature	
O in	nside diameter of the tube	
O le	ength of the resonating air column	
O AI	II of the above	<b>~</b>
of 0.20	Hz tuning fork is used to create a single resonant tone at a dis 0 m in a resonance tube with a diameter of 0.01 m. The tone hength of	
O.	.002 m	
0 0.	.81 m	<b>~</b>
0 1.	.00 m	
O 5.	.20 m	
A 384 inside	Hz tuning fork produces standing waves with a wavelength of a resonance tube. The speed of sound at experimental condit	
A 384 inside		
A 384 inside 34	e a resonance tube. The speed of sound at experimental condit 46.68 m/s 84.90 m/s 26.67 m/s	ions is

# **Extension Questions**



Seismic resonance is responsible for the damage caused to building by earthquakes. Apply the concepts of wave energy and resonance to explain how earthquakes damage the man-made structures. (SAMPLE ANSWER BELOW)

Earthquakes produce traveling mechanical waves known as seismic waves. These waves propagate by vibrating the ground (solid media), water, and to a lesser degree the air, in areas surrounding the epicenter of the earthquake. Energy from the waves also produces vibrations in buildings. If the frequency of the vibrating ground matches the natural frequency of the building, resonance is produced in the form of standing waves that amplify the vibration to levels that can destroy the structures.

