7.1 | Waves - Sound   IB Physics Content Guide

Big Ideas

- Simple harmonic motion is a repeating relationship between an object's position, velocity, and acceleration
- Waves are formed and transferred by particles oscillating in a medium
- All waves have properties can be measured and mathematically related
- Instruments resonate at specific frequencies due to the number of standing waves that fit in the length of the system
- Waves can occupy the same space at the same space to create constructive or destructive interference

Content Objectives

7.1.1 – Simple Harmonic Motion

p. 141-149

I can qualitatively describe the motion of an oscillating system			
I can relate the acceleration of an object in simple harmonic motion to its position			
I can graph the displacement, velocity, and acceleration vs time for simple harmonic motion			
I can interpret an SHM graph to describe the conditions at a specific point in an object's motion			
I can describe and relate the properties of period and frequency			
I can calculate period and frequency from a scenario			
I can qualitatively describe the energy changes that take place during an oscillation			

7.1.2 – Properties of Traveling Waves

p. 150-153

I can describe how waves carry energy through a medium			
I can compare the properties of transverse and longitudinal waves			
I can identify a wave example as transverse or longitudinal			
I can read a wave's amplitude, wavelength, period, and frequency from a graph			
I can label a graph with the location of a wave's crest/compression and trough/rarefaction			
I can describe the number of complete wavelengths represented in a picture			
I can use the wave speed equation to mathematically relate speed, wavelength, and frequency			
I can relate pitch and frequency for sound waves			

7.1.3 – Standing Waves and Sound

p. 190-195

I can describe the motion of a standing wave			
I can identify and label the node and antinodes on a standing wave diagram			
I can calculate the wavelength of a standing wave for different harmonics			
I can describe how harmonics make it possible for one system to resonate at different frequencies			
I can describe the end conditions and nodes/antinodes for open/closed pipes and vibrating strings			
I can relate length and wavelength for open/closed pipes and vibrating strings			
I can calculate the length of a pipe/string required to resonate a specific frequency			

7.1.4 – Speed of Sound and Wave Interference

p. 157-158, 164, 184-186

I can describe why sound travels at different speeds in different media			
I can calculate how far a distant object is by timing an echo			
I can qualitatively and quantitatively interpret cases of constructive and destructive interference			
I can add up two waves with superposition to create a new waveform			
I can describe applications and real-world examples for wave interference			
I can use wavelength and source distance to identify maxima and minima for interference			

7.1 | Waves - Sound

Shelving Guide

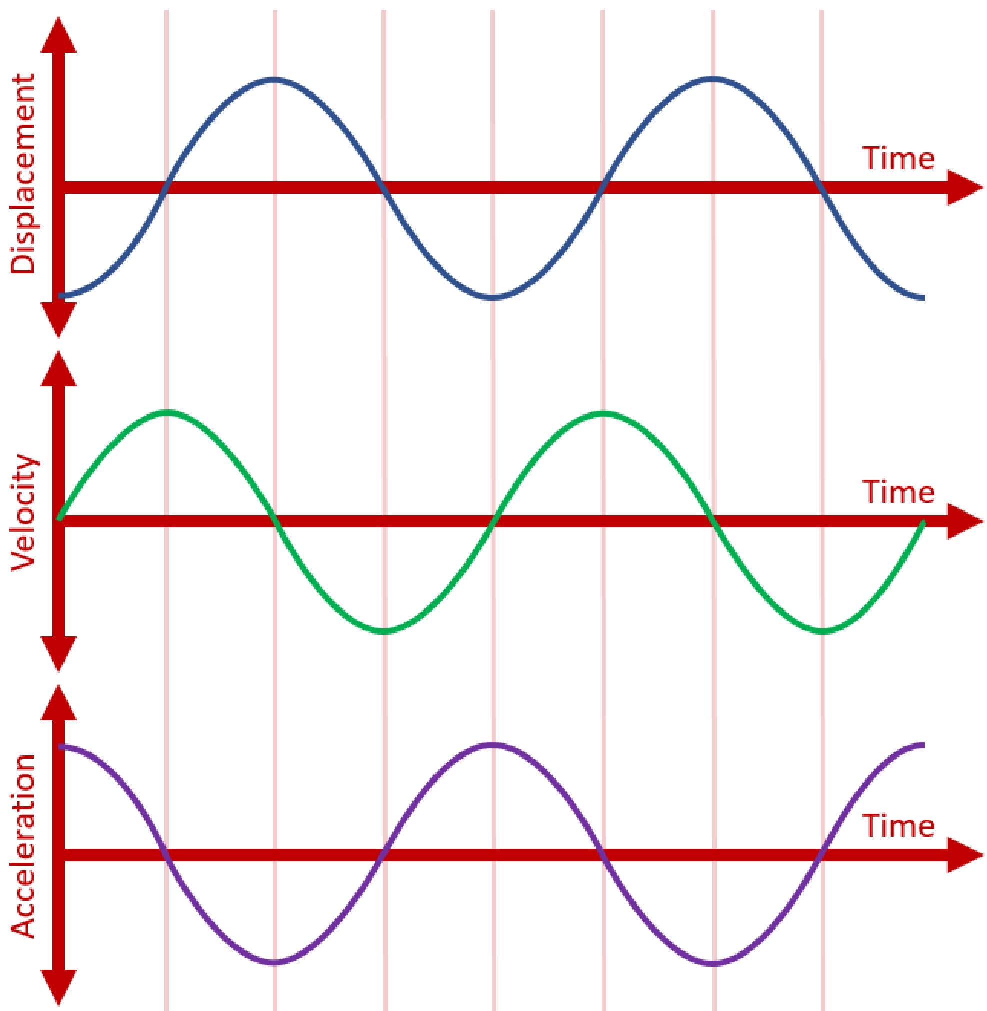
	Variable Symbol	Unit
Period	T	s
Frequency	f	Hz
Wavelength	λ	m
Amplitude	A	m
Wave Speed	v	m s^{-1}

Data Booklet Equations:

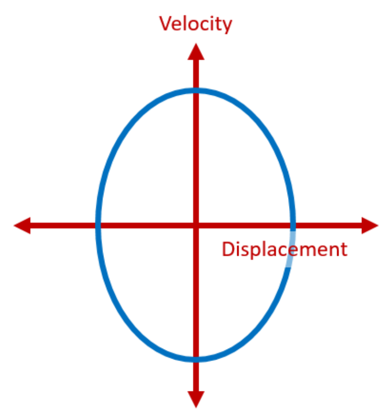
$$T = \frac{1}{f}$$

$$c = f\lambda$$

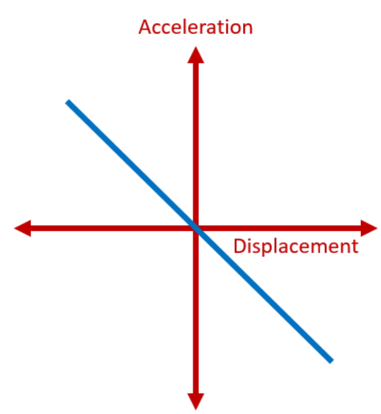
Simple Harmonic Motion Graphs



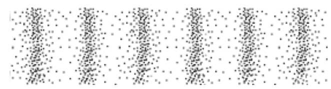
Velocity vs Displacement



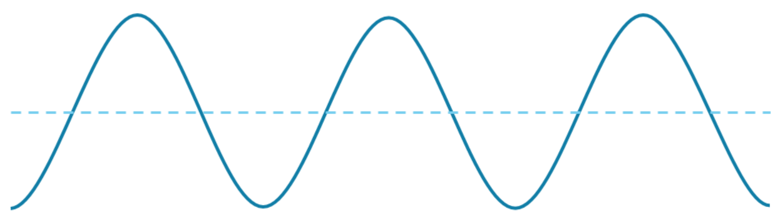
Accel. vs Displacement



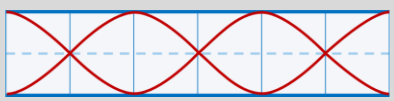
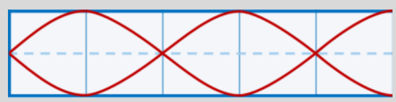
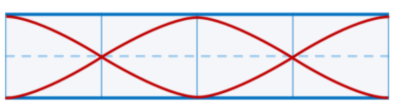
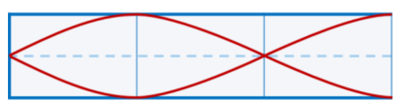
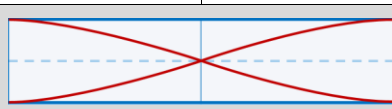
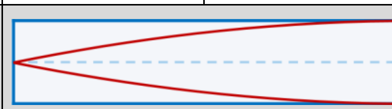
Types of Waves

	Picture	Definition	Examples
Transverse		Particles move **perpendicular** to the motion of the wave	• Light • Ripples in a Pond • Earthquakes
Longitudinal		Particles move **parallel** to the motion of the wave	• Sound • Earthquakes

Parts of a Wave

Label the Wave: • Amplitude • Wavelength • Crest • Trough	

Harmonics

	Open Pipe		Closed Pipe		String	
End Conditions	Antinode	Antinode	Node	Antinode	Node	Node
3rd Harmonic						
	$L = \frac{3}{2}\lambda$	$\lambda = \frac{2}{3}L$	$L = \frac{5}{4}\lambda$	$\lambda = \frac{4}{5}L$	$L = \frac{3}{2}\lambda$	$\lambda = \frac{2}{3}L$
2nd Harmonic						
	$L = 1\,\lambda$	$\lambda = 1\,L$	$L = \frac{3}{4}\lambda$	$\lambda = \frac{4}{3}L$	$L = 1\,\lambda$	$\lambda = 1\,L$
1st Harmonic (Fundamental)						
	$L = \frac{1}{2}\lambda$	$\lambda = 2\,L$	$L = \frac{1}{4}\lambda$	$\lambda = 4\,L$	$L = \frac{1}{2}\lambda$	$\lambda = 2\,L$

Interference

Constructive	Path Difference = $n\,\lambda$	*Destructive*	Path Difference = $(n + ½)\,\lambda$