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

1 – Simple Harmonic Motion

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			

2 – Properties of Traveling Waves

I can describe how waves carry energy through a medium			
I can compare the properties of transverse and longitudinal waves			
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			

3 – Sound

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 describe the motion of a standing wave			
I can identify and label the node and antinodes on a standing wave diagram			

4 – Instruments

I can identify and label the node and antinodes on a standing wave diagram			
I can describe the end conditions and nodes/antinodes for open/closed pipes and vibrating strings			
I can calculate the wavelength or instrument length of a standing wave for different harmonics			

5 – Wave Interference

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			

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Shelving Guide

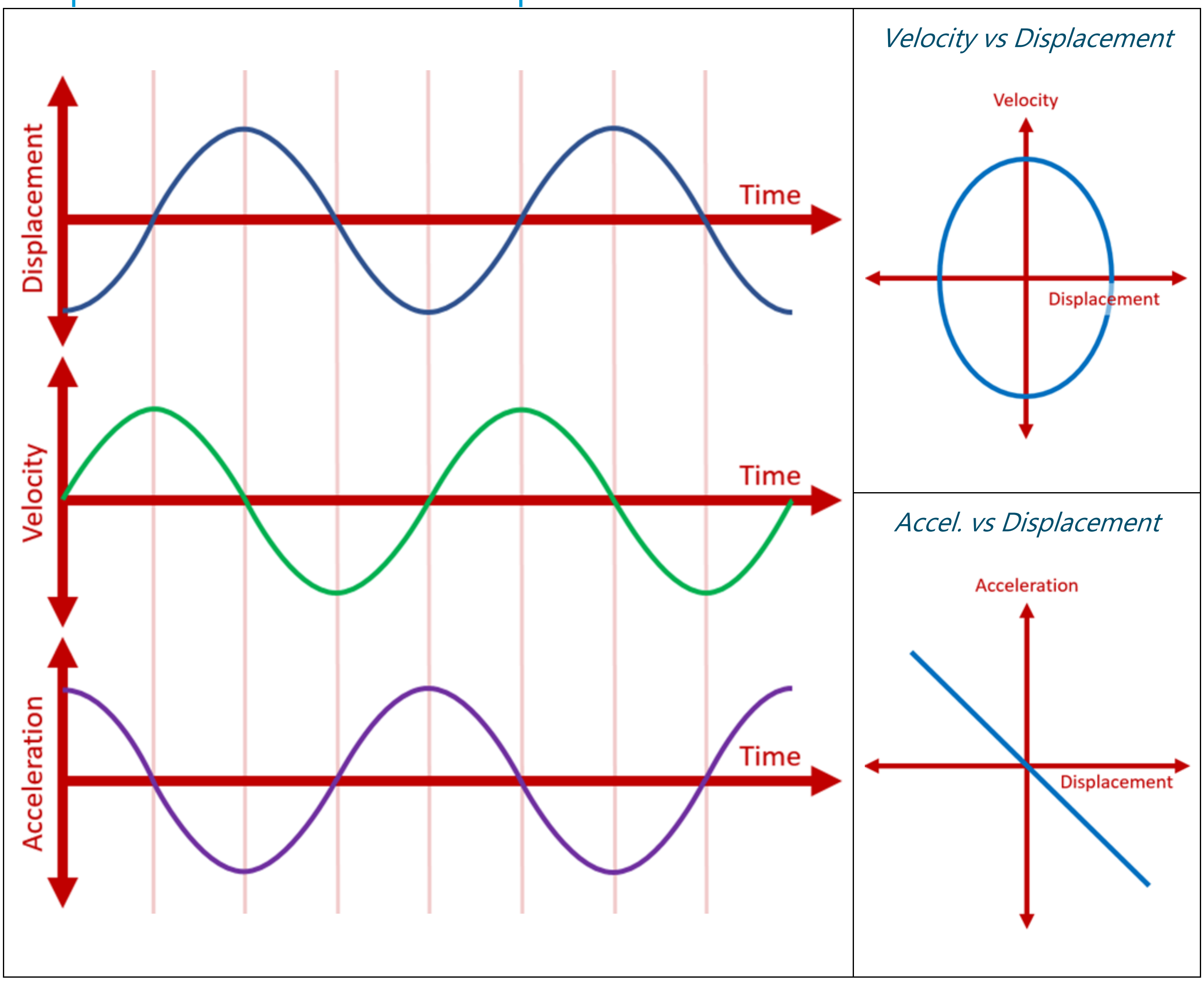
	Variable Symbol	Unit
Period	T	s
Frequency	f	Hz
Wavelength	λ	m
Amplitude	A	m
Wave Speed	v	$m\ s^{-1}$

Data Booklet Equations:

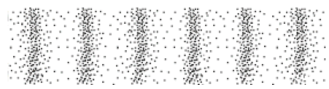
$$T = \frac{1}{f}$$

$$c = f\lambda$$

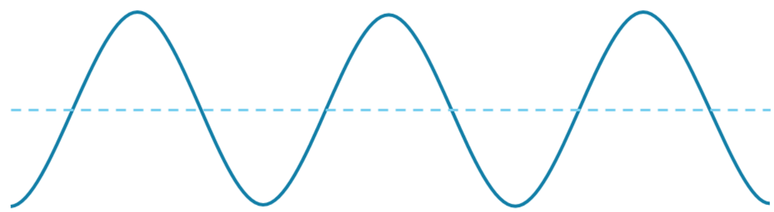
Simple Harmonic Motion Graphs



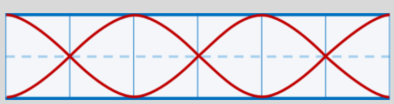
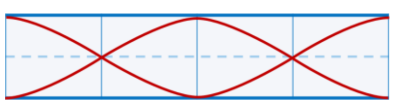
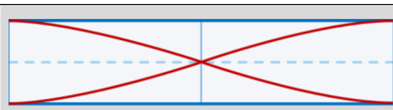
Types of Waves

	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

<u>Label the Wave:</u> • Amplitude • Wavelength • Crest • Trough	

Harmonics

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

Interference

Constructive	Path Difference = $n\lambda$	*Destructive*	Path Difference = $(n + \frac{1}{2})\lambda$