# 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 | | | |

# Waves - Sound

Shelving Guide

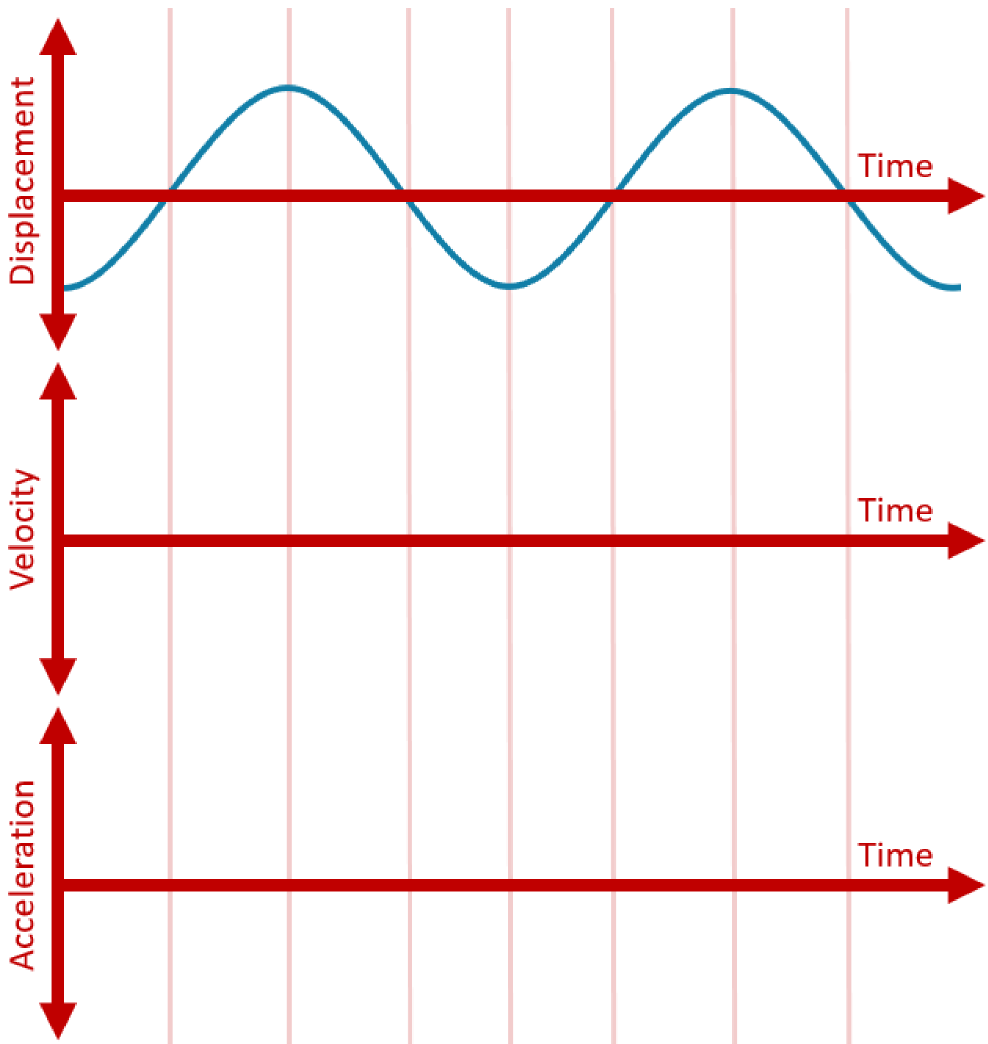
| | Variable Symbol | Unit |
|---|---|---|
| Period | | |
| Frequency | | |
| Wavelength | | |
| Amplitude | | |
| Wave Speed | | |

*Data Booklet Equations:*

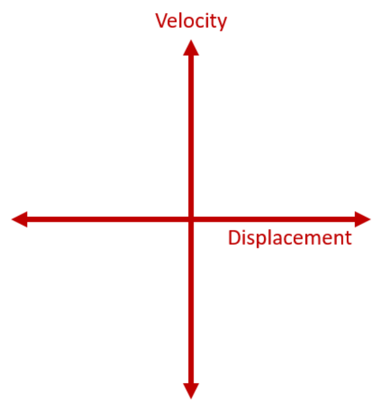
$$T = \frac{1}{f}$$

$$c = f\lambda$$

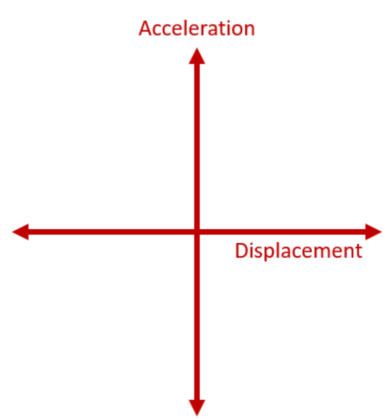
## Simple Harmonic Motion Graphs




*Velocity vs Displacement*

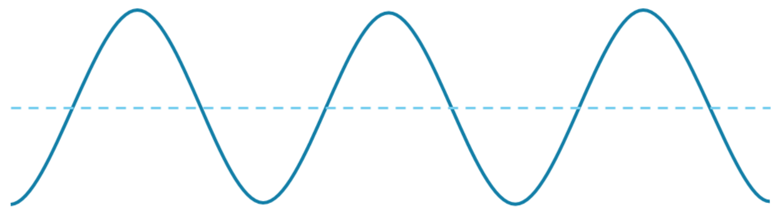



*Accel. vs Displacement*

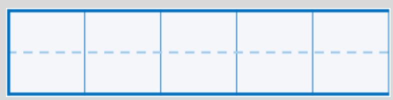
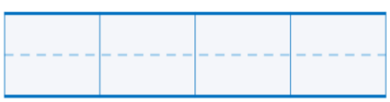


| Types of Waves | Picture | Definition | Examples |
|---|---|---|---|
| Transverse | | | |
| Longitudinal | | | |

## Parts of a Wave

| | |
|---|---|
| **Label the Wave:**<br>• Amplitude<br>• Wavelength<br>• Crest<br>• Trough |  |

## Harmonics

| | Open Pipe | Closed Pipe | String |
|---|---|---|---|
| End Conditions | | | |
| 3rd Harmonic |  |  | |
| | L = (          ) × λ | L = (          ) × λ | L = (          ) × λ |
| 2nd Harmonic |  |  | |
| | L = (          ) × λ | L = (          ) × λ | L = (          ) × λ |
| 1st Harmonic (Fundamental) |  |  | |
| | L = (          ) × λ | L = (          ) × λ | L = (          ) × λ |

## Interference

| *Constructive* | Path Difference = | *Destructive* | Path Difference = |
|---|---|---|---|
| | | | |