|  |  |
| --- | --- |
| **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 |  | *Data Booklet Equations:* |
| Period | T | s |  |  |
| Frequency | *f* | Hz |  |
| Wavelength | λ | m |  |  |
| Amplitude | A | m |  |  |
| Wave Speed | v | m s-1 |  |  |

## Simple Harmonic Motion Graphs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | | Velocity vs Displacement | |
| Accel. vs Displacement | |
| Types of Waves | Picture | Definition | | Examples |
| Transverse | https://sites.google.com/site/waveslightandsoundunit/_/rsrc/1467886271961/03---unit-lessons/03---sound-waves/Wave%20-%20Sound%20wave.gif?height=204&width=357 | Particles move **perpendicular** to the motion of the wave | | * Light * Ripples in a Pond * Earthquakes |
| Longitudinal | https://sites.google.com/site/waveslightandsoundunit/_/rsrc/1467886271961/03---unit-lessons/03---sound-waves/Wave%20-%20Sound%20wave.gif?height=204&width=357 | 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 |  | |  | |  | |
|  | |  | |  | |
| 2nd Harmonic |  | |  | |  | |
|  | |  | |  | |
| 1st Harmonic  (Fundamental) |  | |  | |  | |
|  | |  | |  | |

## Interference

|  |  |  |  |
| --- | --- | --- | --- |
| Constructive | Path Difference = *n λ* | Destructive | Path Difference = (*n* + ½) *λ* |
|  | |  | |