PHYSICS

RESONANCE

MECHANICAL RESONANCE AND STANDING WAVES

Resonant Frequency:

Ways of Obtaining Resonant Frequency

1. **Mechanical Resonance** -

Ex.

http://www.youtube.com/watch?v=j-zczJXSxnw

2. **Acoustic Resonance** -

Ex.

http://www.youtube.com/watch?v=nHSGd2X1nc8&feature=related

http://www.youtube.com/watch?v=oXV45t6wlWU&feature=related

STANDING WAVES

Standing Wave:

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RESONANCE

MODES OF VIBRATION

Strings

A vibrating string stretched between two fixed points will have nodes at each end. The simplest mode a string can vibrate is called the **FUNDAMENTAL FREQUENCY** or the **1st Harmonic**.

FUNDAMENTAL FREQUENCY
1st HARMONIC

The string may also vibrate in multiples of the fundamental frequency, called ***Harmonics***. These additional modes of vibration that produce a viable sound are called ***Overtones***.

1st OVERTONE
2nd HARMONIC

2nd OVERTONE
3rd HARMONIC

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MODES OF VIBRATION

COLUMNS

Open Columns - Open columns are open at both ends.

FUNDAMENTAL FREQUENCY
1st HARMONIC

_____

_____

1st OVERTONE
2nd HARMONIC

_____

_____

2nd OVERTONE
3rd HARMONIC

_____

_____

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RESONANCE

MODES OF VIBRATION

COLUMNS

Closed Columns- Closed columns are closed at one end.

FUNDAMENTAL FREQUENCY
1st HARMONIC

The second harmonic (double the fundamental) does not produce a sound.

2nd HARMONIC
NOT an OVERTONE
(No Sound)

Therefore the 1st overtone doesn't occur until the 3rd harmonic.

1st OVERTONE
3rd HARMONIC

2nd OVERTONE
5th HARMONIC

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MODES OF VIBRATION

SUMMARY

	STRINGS	OPEN COLUMN	CLOSED COLUMN
Fundamental Frequency			
1st Overtone			
2nd Overtone			
3rd Overtone			

(#) – The Harmonic

No two sounds are exactly alike. Sounds can differ in three different ways:

Pitch -

High Pitched Low Pitched

Amplitude -

High Amplitude Low Amplitude

Quality -

High Quality Low Quality

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Ex. A standing wave is produced on a 6.0 m rope using a 5.5 Hz source. If there are three antinodes between the ends, what is the speed of the waves that produced the pattern?

Ex: An organ pipe, open at both ends, is 2 m long. A sound is played through the pipe at the 3rd harmonic. If the speed of sound in the room is 340 m/s, what is the frequency of the sound?

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Ex: A closed pipe has a length of 3 m. A sound at the 5 resonant length is produced by the column. If the temperature of the room is 22°C, what is the frequency of the sound?