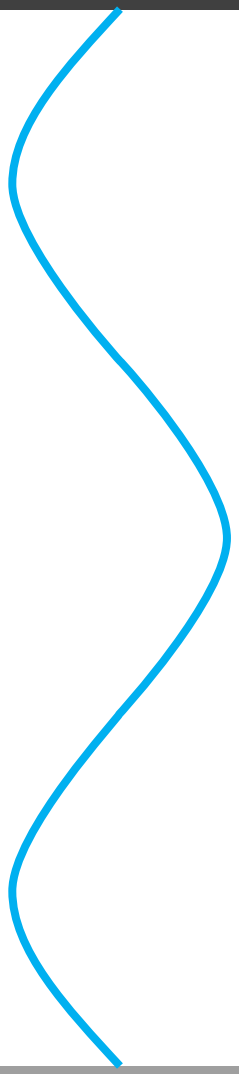
C.4

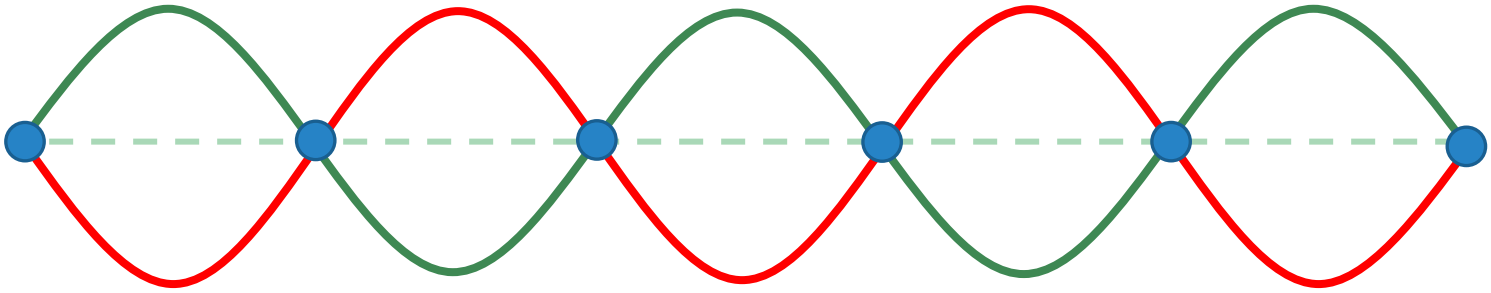
# Instruments

IB PHYSICS | WAVE RESONANCE

# Standing Waves

C.4





# Standing Waves

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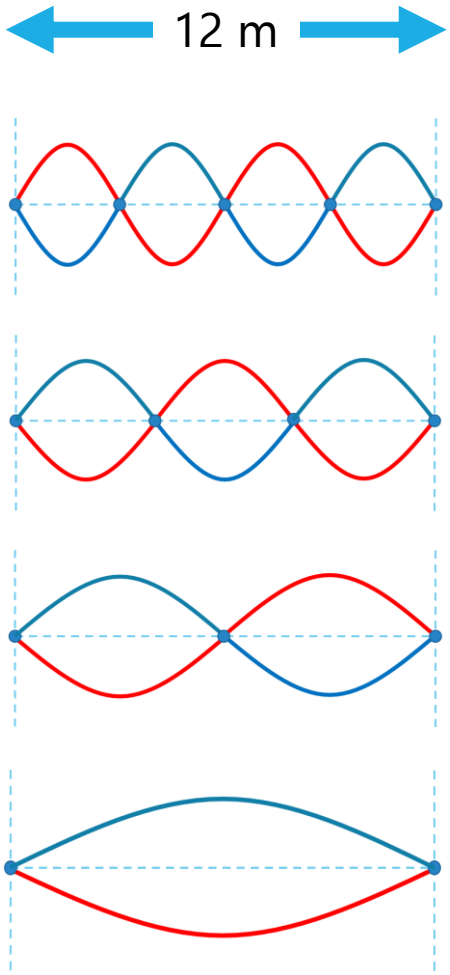
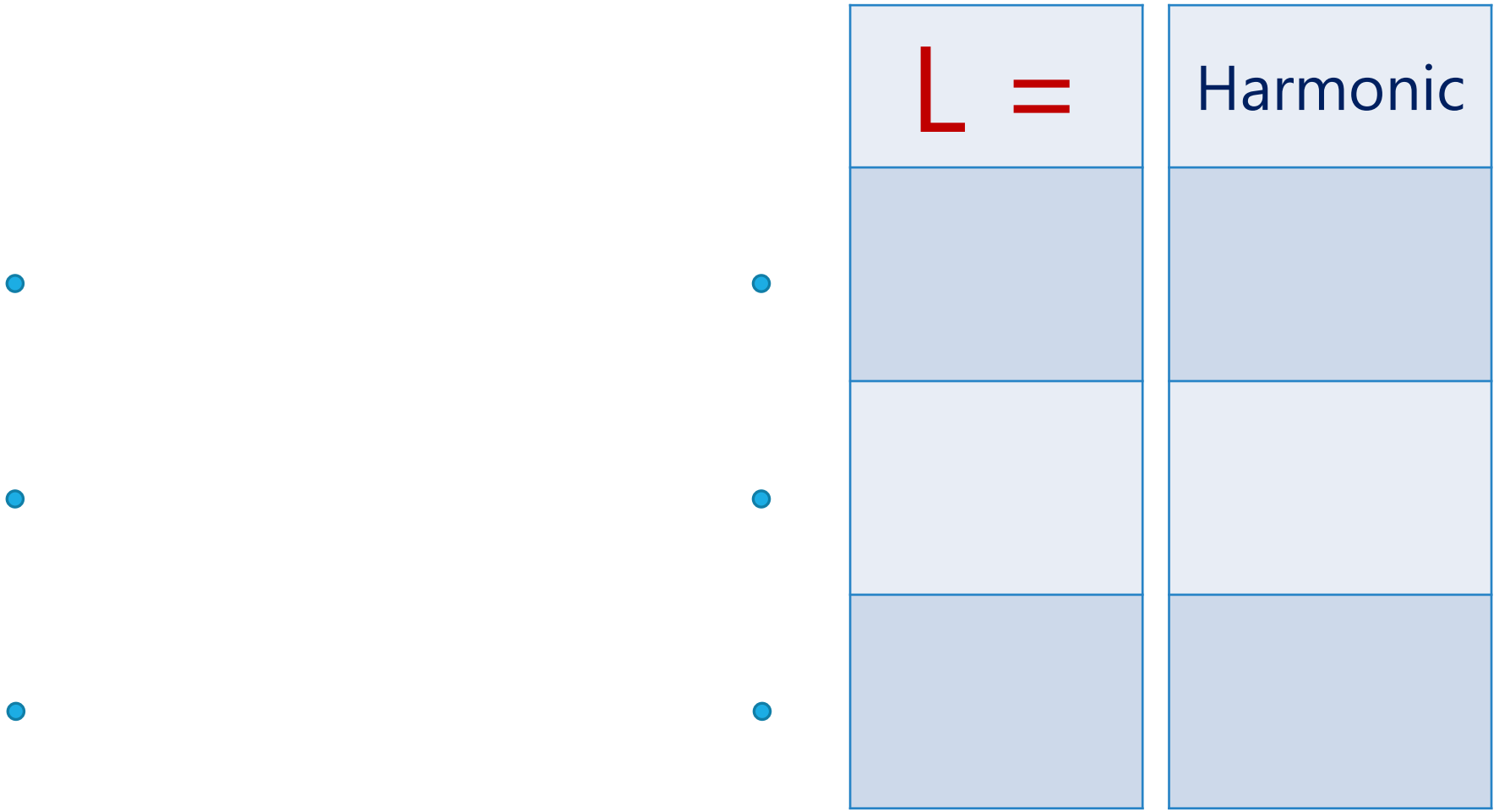



| # of Standing Waves | # of Wavelengths | Wavelength (m) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

# String Resonance

C.4



C.4

# Looking at a Guitar

What is the first harmonic frequency for a 65 cm string with a speed of 106.6 m $s^{-1}$?

| Changing the Length | Changing the Tension |
| --- | --- |
| Finger position on fret changes length to 45 cm | Tightening the string increases speed to 120 m $s^{-1}$ |

# Open Pipe Resonance

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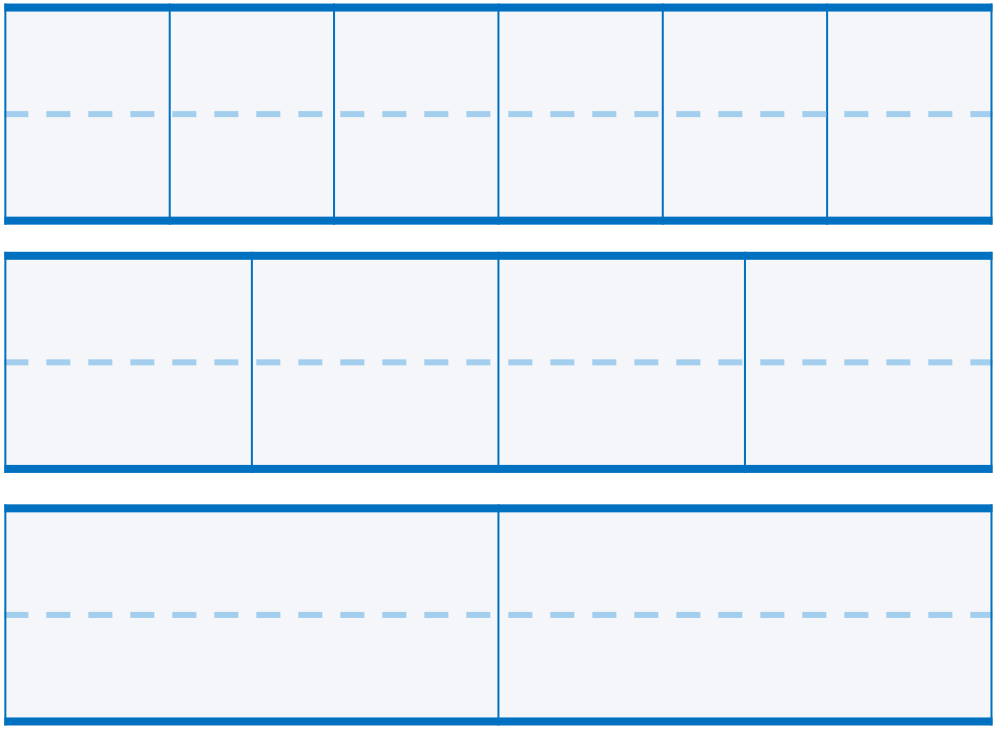

| L = | Harmonic |
| --- | --- |
| | |
| | |
| | |

# Remember Pitch and Frequency

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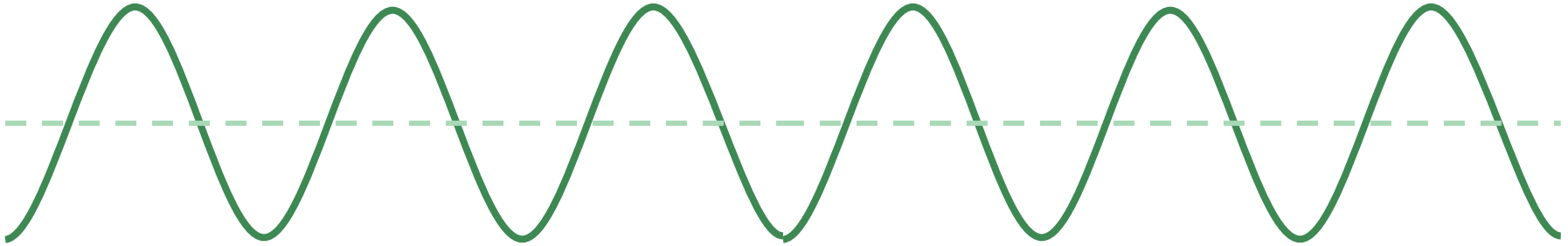
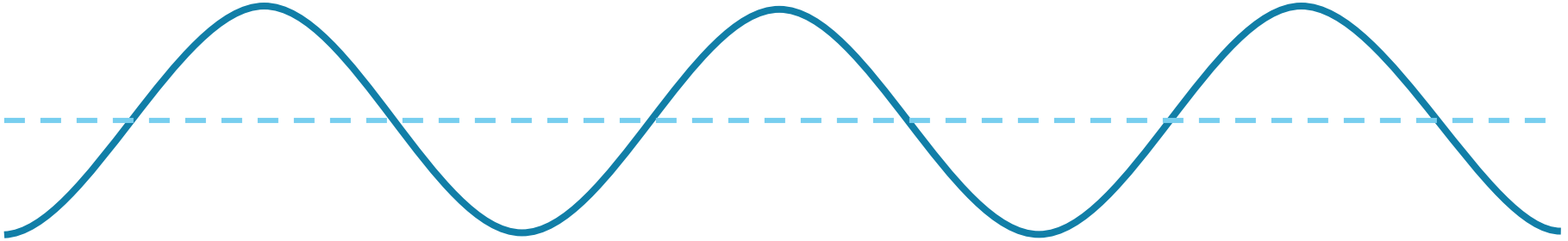
High pitched sounds have high frequencies



Low pitched sounds have low frequencies



# Harmonics

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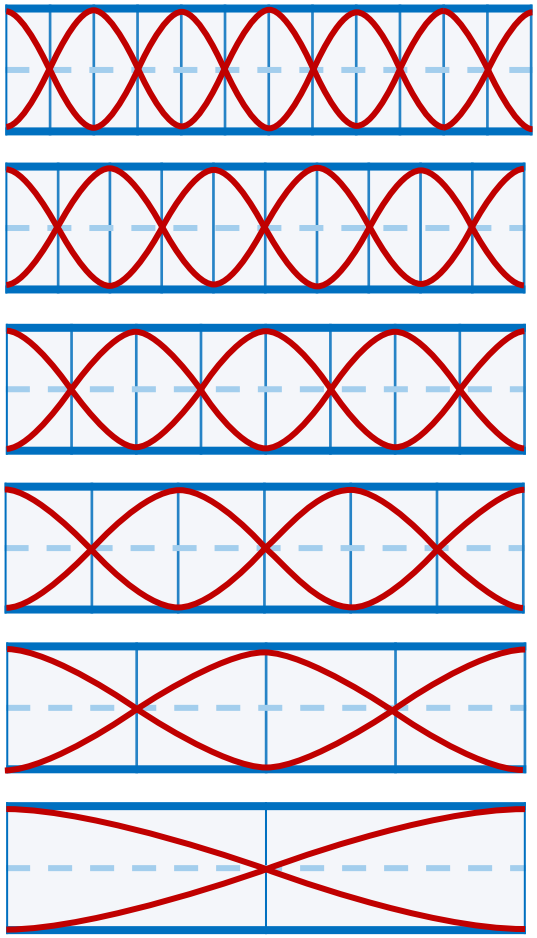
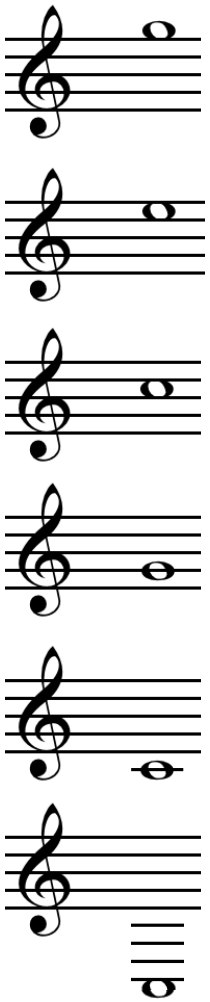
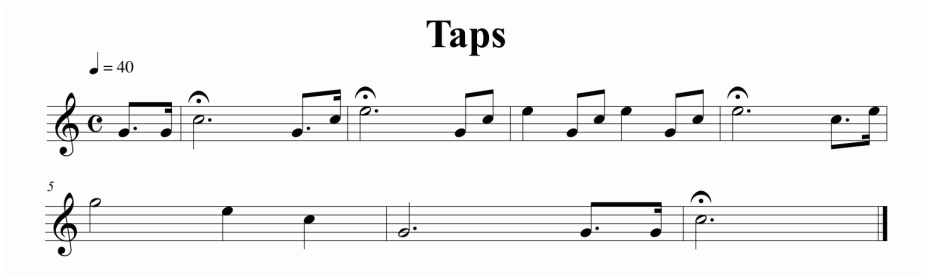
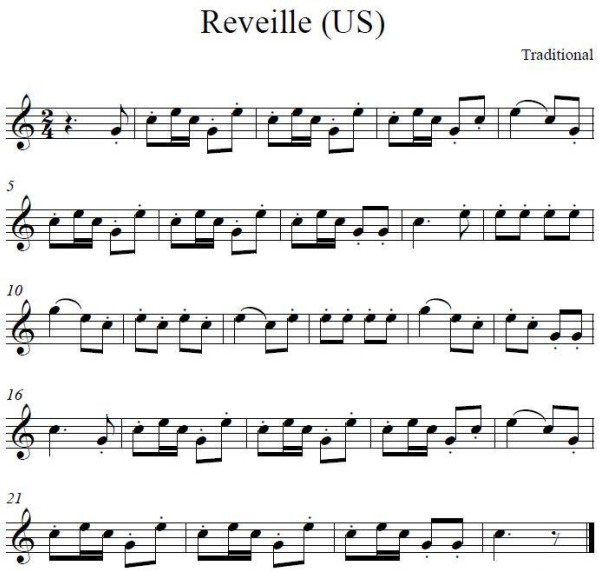


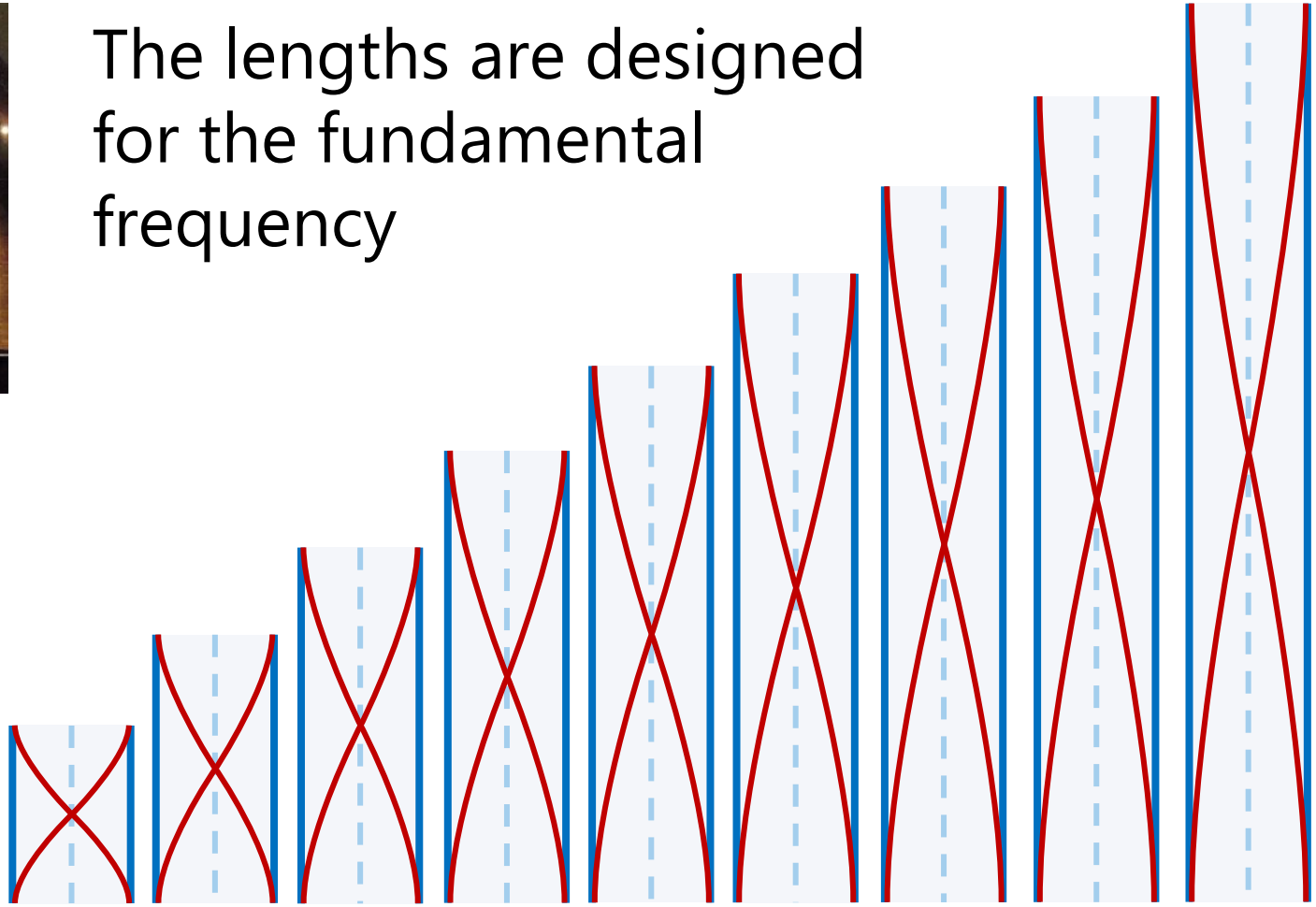






# Changing the Length

The lengths are designed for the fundamental frequency



# Calculating Frequency | Open Pipes

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An open organ pipe is 2.1 m long and the speed of sound in the pipe is 341 m/s. What is the fundamental frequency of the pipe?

# Closed Pipe Resonance

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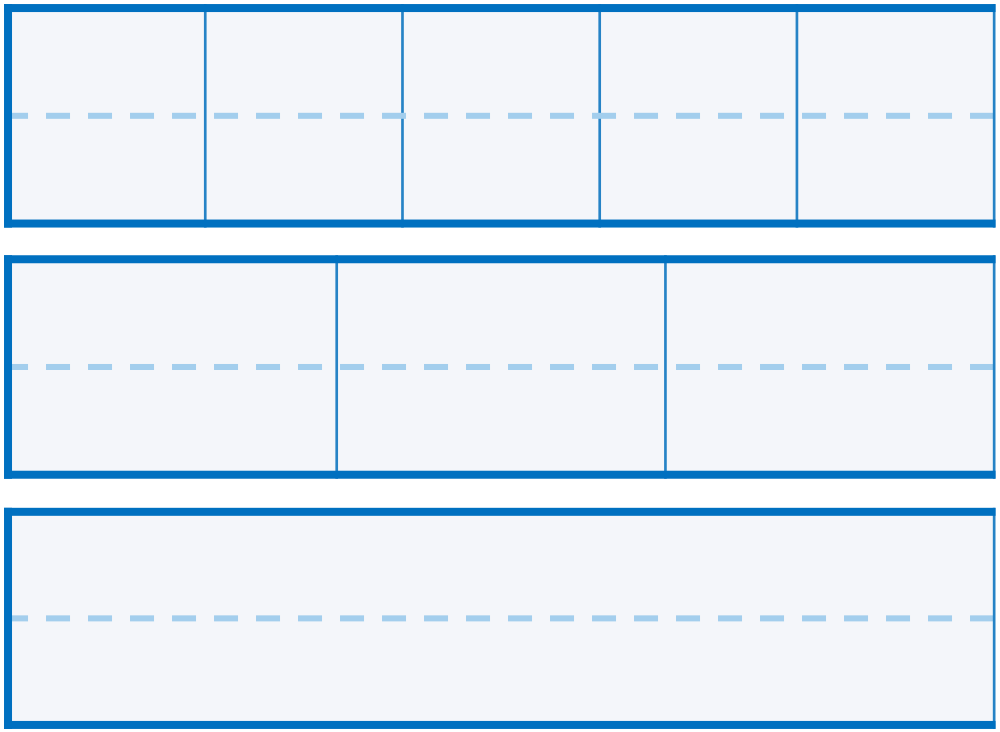
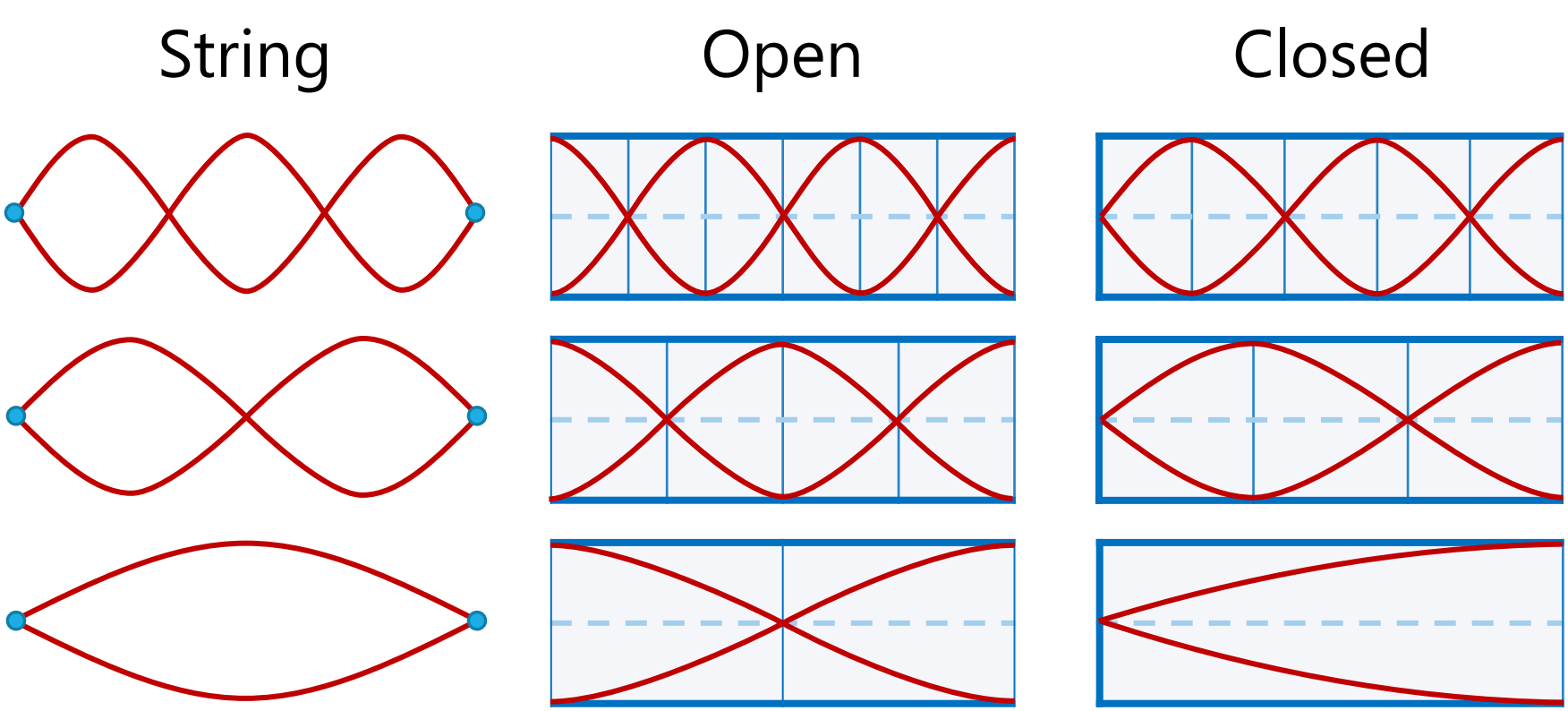


| L = | Harmonic |
| --- | --- |
| | |
| | |
| | |

# All the Harmonics!



# Review of End Conditions

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| | | |
|---|---|---|
| Closed Pipe | | |
| Open Pipe | | |
| String | | |

# Try This…

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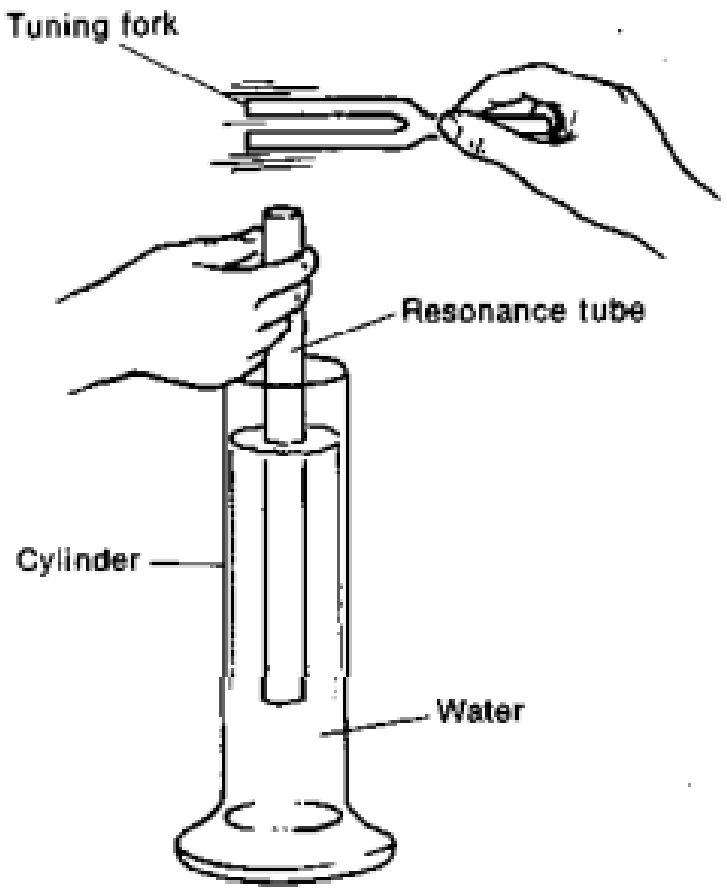
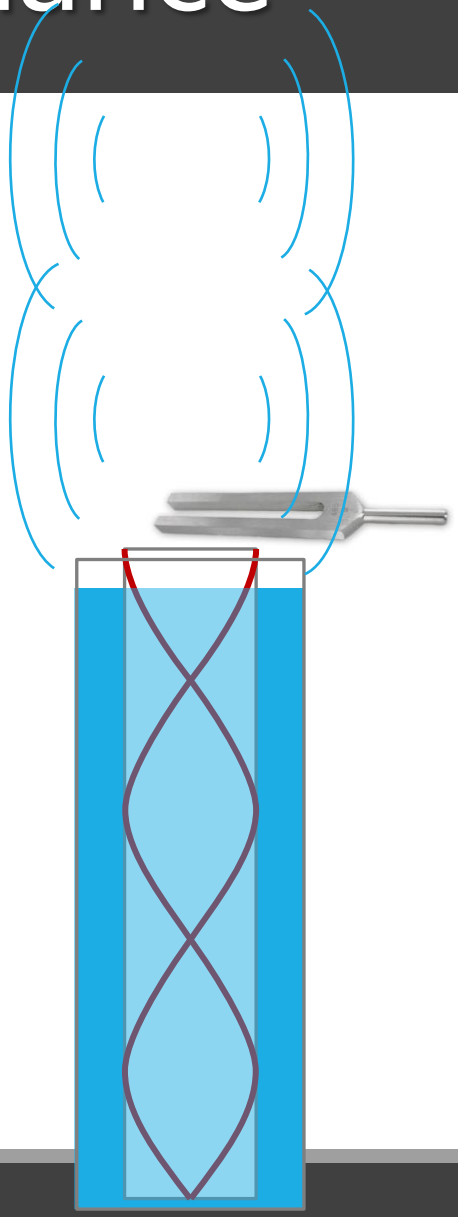
The note produced on a violin string of length 42 cm produces a wave speed of 250 m/s. What is the 3rd harmonic of this note?

# Finding Resonance

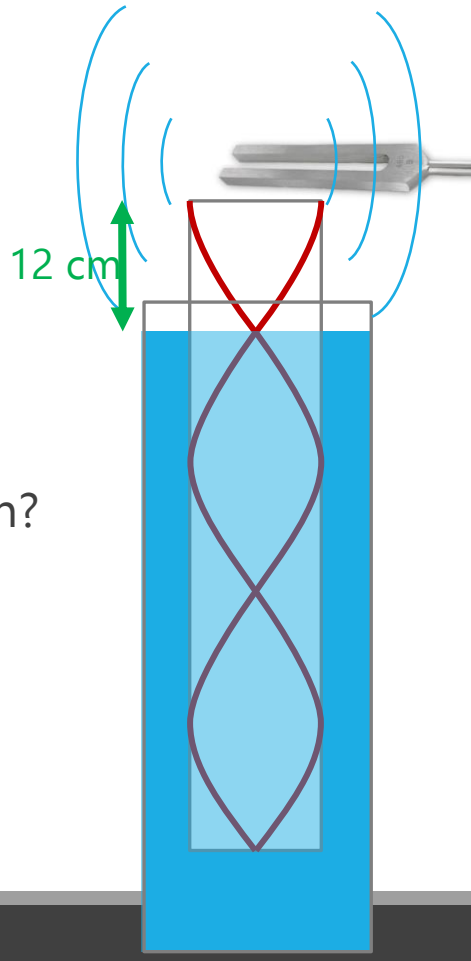


# Calculating Frequency | Closed Pipes

C.4

You found an unmarked tuning fork in your collection. You notice that the smallest length for closed pipe resonance is **12 cm**. If the speed of sound is **345 m/s**, what is the tuning fork frequency?




What should the length of the tube be for the 2nd resonant position?

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# Lesson Takeaways

- ❑ 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 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