IMPORTANT TERMS:

- **Beats**
- **Compression**
- **Forced vibration**
- **Infrasonic**
- **Natural frequency**
- **Pitch**
- **Rarefaction**
- **Resonance**
- **Ultrasonic**

EQUATIONS:

$$v = \lambda f$$

$$v = \frac{d}{t}$$

$$T = 2\Pi\sqrt{\frac{L}{g}}$$

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

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

UNIT IV: SOUND AND LIGHT
Chapter 25-31

Chapter 26: Sound

I. The Origin of Sound (26.1)

A. **All sound is produced by** _____ **in an object**

1. Vibrating strings, reed, vocal chords

2. In each case, original vibration stimulates the vibration of something larger or more massive

a. E.g. _____ of a stringed instrument, air column within reed or wind instrument, air in the throat and mouth of singer

b. Then vibrating material sends _____ through a surrounding medium (usually the air)

3. Under ordinary conditions, **frequency** of vibrating source _____ the **frequency** of **sound waves produced**.

B. **Frequency** of sound wave called _____

1. Young person hears pitches from _____ **to** _____ **hertz**.

2. As we get older hearing range _____

3. Sound waves below 20 hertz called _____

4. Sound waves above 20,000 hertz called _____

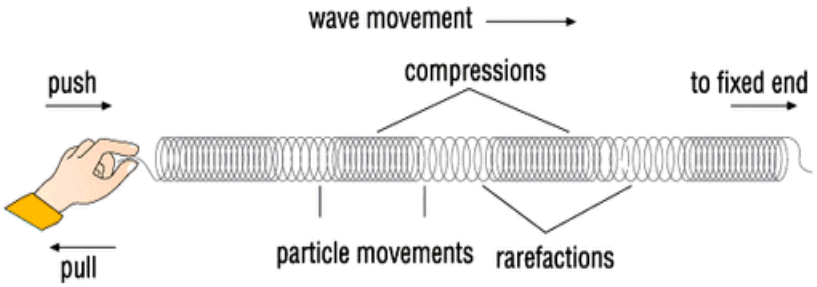
5. Cannot _____ ultrasonic or infrasonic sound waves

II. Sound in Air (26.2)

A. Vibration creates _____ in air

1. **travels** out in **all** _____

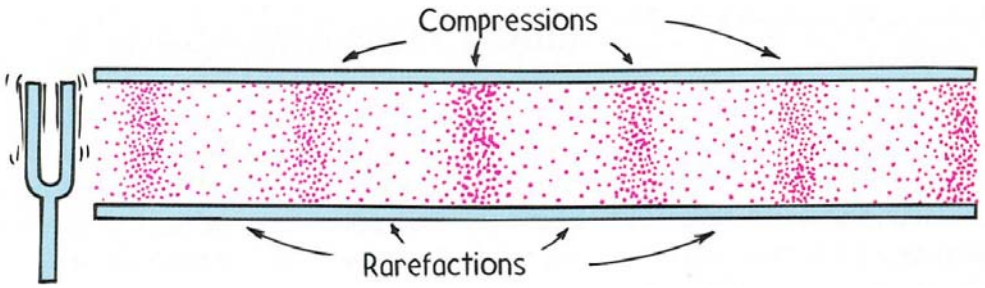
2. **Energy** moves like _____ wave in spring



3. Pulse of compressed air is called a _____.

4. Areas of lower-pressure air in between compressions called _____ (rarefied regions)

B. For all waves, it is <u>not</u> the _____ that travels, but a _____ that travels.



III. Media that Transmit Sound (26.3)

A. <u>Most sounds</u> you hear are transmitted through _____

B. **Solids** and **liquids** are generally **_____** of sound

1. In general sound transmitted _____ in **liquids** than _____

2. <u>Faster still</u> in _____

C. Sound **cannot** travel in a _____

1. **Transmission of sound requires a** _____

2. There may be a vibration, but without medium, no sound

IV. Speed of Sound (26.4)

A. Speed of sound in dry air at 0°C is about _____ **m/s** (or about 1200 kilometers per hour)

1. **Water vapor** in air _____ speed slightly

2. **Increased temperature** <u>increases</u> _____ (For each degree increase in air temperature, the speed increases by _____)

3. **Speed at room temperature of about 20°C is** _____

B. Speed of sound in a material depends on its _____ <u>not</u> its _____

1. **Elasticity** is ability of material to change _____ in response to an applied force, and then <u>resume</u> its initial shape. Once distortion is removed (steel elastic,

putty is inelastic)

2. Sound travels ____ times faster in steel than air, ____ times faster in water

V. Loudness (26.5)

A. **Intensity** of a sound waves is _____ **to** _____ **of amplitude** of a sound wave

1. An _____ measurement

2. Use _____ to measure

B. **Loudness** is a physiological sensation sensed in the brain

1. Is a _____ measurement, but related to **sound intensity**

2. Loudness varies as the _____ of intensity (**powers of** _____)

C. Intensity measured in _____ **(dB)**

1. _____ **dB** threshold of hearing for normal ear

2. Increase of 10 dB is increase by factor of ____ (20 dB is _____times more intense than 0 dB)

COMPARISON OF SOUND INTENSITY & SOUND PRESSURE LEVEL

Sound Intensity or Pressure	Sound Pressure Level in dB	Typical Sounds
1,000,000,000,000	120	Thunder Clap
100,000,000,000	110	Nearby Riveter
10,000,000,000	100	Boiler Factory/Subway
1,000,000,000	90	Loud Street Noise/Noisy Factory
100,000,000	80	Noisy Office
10,000,000	70	Average Street Noise
1,000,000	60	Average Radio/Average Office
100,000	50	Average Conversation
10,000	40	Quiet Radio/Private Office
1,000	30	Average Auditorium
100	20	Quiet Conversation/Whisper
10	10	Soundproof Room
1	0	Threshold of Audibility

VI. Forced Vibration (26.6)

A. **Forced vibration**- like the soundboard on a guitar. Is forced to vibrate by vibrations of strings

B. Increases the _____. Important for all _____ musical instruments

VII. Natural Frequency (26.7)

A. Every object composed of an elastic material will vibrate at its own special set of frequencies when disturbed, which together form its special sound. Natural frequency- _____ to each object

B. **natural frequency** is one at which **minimum** _____ is required to produce forced vibrations and frequency that requires the least energy to continue vibration

VIII. Resonance (26.8)

A. **resonance**- increase in _____ when frequency of forced vibration matches the objects natural frequency.

1. resonance means to “resound” of “sound again”

2. requires _____ to pull it back to starting position and enough energy to keep it vibrating

B. Resonance <u>not</u> restricted to _____ motion

1. Occurs whenever successive _____ are applied to vibrating object in rhythm with its natural frequency

2. Example-

IX. Interference (26.9)

A. Sound waves (like any waves) can be made to interfere

1. Crest overlaps crest of another wave (**constructive interference**) = _____ in amplitude

2. Crests overlaps troughs of another wave (**destructive interference**) = _____ in amplitude

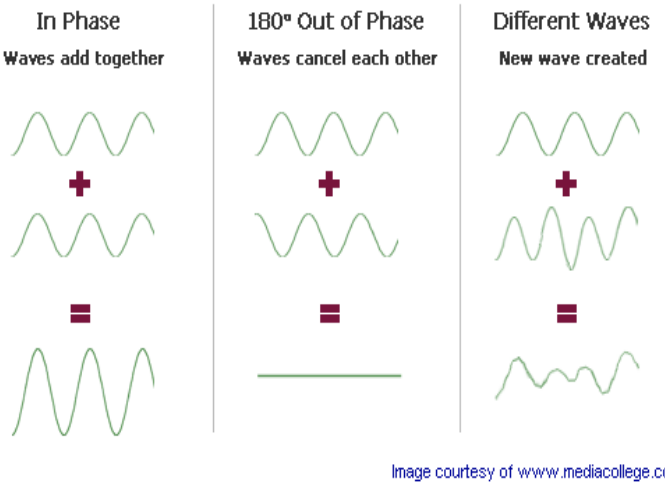


Image courtesy of www.mediacollege.com

B. Interference affects loudness

1. Waves arrive ___ _____ then waves **add**

2. Waves arrive _____ of _____ then destructive

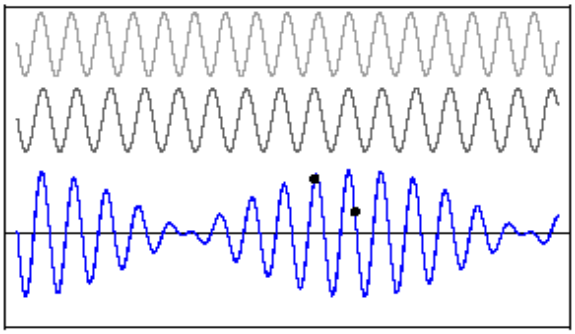
X. Beats (26.10)

A. Interesting case of interference

1. Occurs when tones of slightly different _____ are sounded together.

2. Fluctuation of loudness of combined sounds is heard (sound is loud, then faint, then loud, then faint, and so on)

3. Called _____



B. Beats can occur in any kind of waves

1. Used to _____ musical instruments

2. When frequencies the <u>same</u> the beats _____