Grade 11 Notes May 11-15, 2020

Hope you are well. Hopefully, you are keeping up with all your school work. Remember that even though we are not together you still need to learn grade 11 material for grade 12 classes.

Last week we finish our unit of Conservation of Energy and Thermal Energy. This week we are going to start our unit on Waves and Sound with the following notes.

1. Introduction to Waves

2. Speed of Sound

3. The Ear and Hearing

Remember to submit your assignment from last Thursday on Wednesday this week. I will not be sending out an assignments this week as I think we need a break over the long weekend. I will resume with assignments next Thursday. Maybe take this opportunity to complete any assignments you haven't completed so far. Questions email me.

Have a good week.

Miss Takken

Early piñatas

1. Introduction to Waves

Sound ~ a form of energy that enables communication and provides us with information about our environment.

i.e. you can tell what type of mood your friend is in by the tone of their voice, hear a siren and you know that there is a problem somewhere, music, ultrasound etc.

** For sound to be created there must be a vibration.

Vibration ~ a regularly repeated motion that occurs at regular time intervals.

Cycle ~ one complete motion of a vibration, for a pendulum this is the travelling of 4 complete amplitudes.

Rest Position ~ where the object will remain at rest , an object may move through its rest position.

Amplitude~ the distance for the maximum displacement from the rest position in either direction.

Frequency (f) ~ the number of complete cycles in a unit of time~ f = cycles / time (Hz)

Period (T) ~ the time required to complete one cycle ~ T = time/cycle (s)

$$f = 1/T, \quad T = 1/f$$

Transverse Vibration ~ the object vibrates perpendicular to its length. i.e. a pendulum, a tree swaying in the wind, a kid on a swing.

Longitudinal Vibration ~ the object vibrates parallel to its length i.e. a child on a pogo stick, shocks on a car, mass on a spring.

Torsional Vibration ~ the object vibrates by twisting about its length i.e. the agitator in a washing machine, torsional clock, door knobs, The Tacoma Narrows Bridge collapse. Watch clip of collapse at the following link. https://www.youtube.com/watch?v=j-zczJXSxnw

** Vibrations create waves!

Wave ~ a disturbance which carries energy from one place to another without the transfer of the medium itself. (Energy that travels through a medium without causing any displacement of the medium it is travelling through).

1. **Transverse Wave** ~ wave in which the particles of the medium vibrate perpendicularly to the direction of the motion of the wave. i.e. water wave.

Wavelength (λ) ~ the distance covered in one complete cycle.

Pulse ~ a single disturbance equal to half of a wavelength.

Crest ~ a single disturbance (pulse) that is positioned above the rest position, a positive pulse.

Trough ~ a pulse positioned below the rest position, a negative pulse.

In-phase ~ a description of particles that are the same distance from the rest position and are travelling in the same direction (at least one wavelength apart).

Out of Phase ~ not in-phase, the particles are travelling in opposite directions and/or are not the same distance from the rest position.

2. **Longitudinal Wave** ~ a wave in which the particles of the medium vibrate parallel to the direction of motion (i.e. a slinky, **sound waves**, a mass on a spring)

Compression ~ regions where molecules are packed together, are condensed or compressed. (high pressure)

Rarefaction ~ regions where molecules are more spaced out (low pressure).

3. **<u>Torsional Wave</u>** ~ a wave in which the particles of a medium vibrate by twisting around the direction of the wave i.e. Tacoma Narrows Bridge, torsional clock.

For torsional waves we speak of clockwise and counterclockwise twists.

** The frequency of a wave is equal to the frequency of its source.

$$v = f\lambda$$

<u>The universal wave equation</u> ~ universal because it may be used with any and all waves !!!

v = speed of wave (m/s)
λ = wavelength (m)
f = frequency of the wave (found by looking at the source) (Hz = 1/s)

Example: Find the speed of a wave that is generated by a 60 Hz source and has a wavelength of 25 cm.

$v = f\lambda$
$v = 60 \times 0.25$
$v = 15$ m/s

2. <u>The Speed of Sound</u>

Sound is a longitudinal wave that requires a medium (material) to travel through. No medium (vacuum) no sound. This is why sound doesn't travel through space. Light can however, which is why radios work in space.
The speed is different for different medium. Generally, the stiffer (more solid) the material, the faster the speed of sound.

Solids molecule proximity allows vibrations caused by sound energy to be easily transmitted.

pg 446 Table 13.1 from textbook for speeds in different mediums.

The Speed of Sound in Air

The speed of sound also depends upon the temperature of the medium.
In air particles move faster as the temperature increases.

The formula to determine the speed of sound at a particular temperature in air is given by

$$v_{air} = 332\text{ m/s} + 0.6\ \frac{\text{m/s}}{^{o}\text{C}}\ T$$

$$v_{air} = 332 + 0.6T$$

where v is the speed of sound in air, 332 m/s is the speed of sound in air at 0^{o}C and T is the temperature of the air in ^{o}C. The 0.6 is a proportionality constant for air.

Example: Find the speed of sound in air if the temperature is 23^0C

$v_{air} = 332 + 0.6T$
$v_{air} = 332 + 0.6(23)$
$v_{air} = 332 + 13.8$
$v_{air} = 345.8$ m/s

Example: Find the temperature outside if the speed of sound is 330 m/s.

$v_{air} = 332 + 0.6T$
$330 = 332 + 0.6T$
$330 - 332 = 0.6T$
$T = (330-332)/0.6$
$T = -3.3\ ^oC$

Now you try pg 449 # 1 - 3, pg 474-475 # 33 - 43 (odd numbers only) and make your own notes on "Mach Numbers and the Sound Barrier" by reading pg 449-452

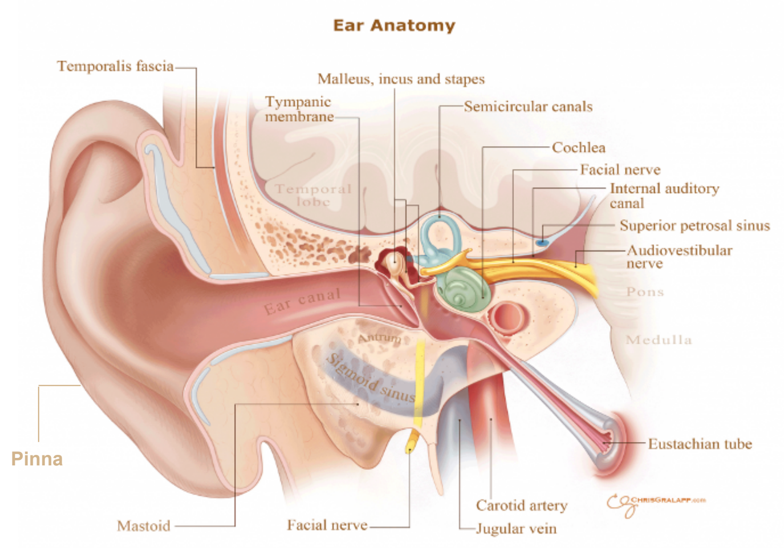
3. The Ear and Hearing

Humans can hear between 20 Hz and 20000 Hz frequency sounds if your hearing is good. As you age your hearing range decreases due to wear and tear on your cilia hairs in your cochlea. Other factors can also affect your hearing range like exposure to loud persistent noises (i.e. factory work or loud machinery) or illness can temporarily or permanently affect your hearing. If we were in class I would discuss my own permanent hearing damage (I wear hearing aids for about 10 years due to illness damaging my hearing range). But we are not so just know I would have had a lot to say about this topic.

Other species hear different ranges of sound with the dolphin being able to hear the highest frequency and the elephant the lowest.

Animal	Hearing range in Hertz
Humans	20 – 20,000
Bats	2000 – 110,000
Elephant	16 – 12,000
Fur Seal	800 – 50,000
Beluga Whale	1000 – 123,000
Sea Lion	450 – 50,000
Harp Seal	950 – 65,000
Harbor Porpoise	550 – 105,000
Killer Whale	800 – 13,500
Bottlenose Dolphin	90 – 105,000
Porpoise	75 – 150,000
Dog	67 – 45,000
Cat	45 – 64,000
Rat	200 – 76,000
Opossum	500 – 64,000
Chicken	125 – 2,000
Parakeet	200 – 8,500
Horse	55 – 33,500

The Ear



Here are the basic steps to how we hear:

1. Sound is created at the source and travels as a longitudinal wave to our ear. The pinna (the outer portion of our ear is shaped like a satellite dish to funnel the sound wave down the ear canal.
2. Sound transfers into the ear canal and causes the eardrum (tympanic membrane) to move. The eardrum will vibrate with the different frequencies of sounds.
3. These sound vibrations make their way through the ossicles (the three smallest bones in the body; the incus, malleus and stapes) to the cochlea.
4. Sound vibrations make the fluid in the cochlea travel like ocean waves. Movement of fluid in turn makes the hair cells (cilia) vibrate. Each hair cell is tuned to a certain frequency of sound. So only a few vibrate with each frequency.
5. The auditory nerve picks up any neural signals created by the hair cells. Hair cells at one end of the cochlea transfer low pitch sound information and hair cells at the opposite end transfer high pitch sound information.
6. The auditory nerve moves signals to the brain where they are then translated into recognizable and meaningful sounds. It is the brain that "hears".

Our hearing process truly connects us to the soundscape of our surrounding environment. Our hearing system provide us with an amazing ability to identify and comprehend the most minuscule acoustic cues. In fact, our brains are capable of storing the neural equivalents of acoustic patterns like music, voices, danger sounds, and environmental sounds. This similarity makes it much easier for us to recognize and process both familiar and unfamiliar sounds.

Hearing loss occurs when sounds that are typically loud become softer and less intelligible; this is a result of our brain being misled through a loss of audibility. Information also becomes distorted as it reaches the brain, disrupting the quality of our hearing.

Head trauma, neurologic disease, medical disorder or the process of simply aging, can result in alterations in the ability of the brain to process stimuli effectively. This can lead to symptoms that reflect hearing loss; such symptoms may include inattention, inappropriate responses, and confusion. Our brain works with our ears in an incredible way, processing neural events into our hearing and all that it involves.

Your ears also contain the semicircular canals which aid in balance. Sometimes if you get an ear infection you can lose your balance. Also, the Eustachian Tube (tube that goes to the throat) which is a tube that drains fluid from the ear and keeps a pressure balanced between the inner and outer ear (think ears popping). If you get a cold the eustachian tube can be block resulting in fuzzy hearing and your ears feeling plugged.