Waves

1) Wave - a disturbance that carries energy through matter or space.

2) Medium - matter through which a wave travels.

3) Mechanical wave - Wave that requires a medium.

4) Electromagnetic Wave - Consist of changing electric and magnetic fields in space.
Note: Does not requires a medium. Example: light

5) Energy - ability to exert a force over a certain distance or to do work.
Note: The bigger the wave is, the more energy it carries.

6) Vibration - back and forth movement of an object.
Note: Most waves are caused by vibrating objects.

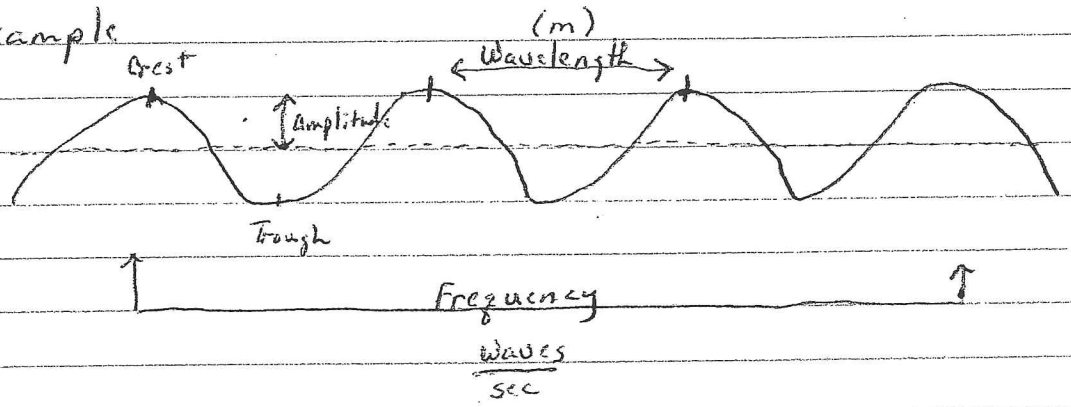
7) Simple harmonic motion - where a spring is expanded or compressed, it exerts a force that moves the mass back to the original resting position.
Note: Mass bounces up and down are Vibration.

8) Damped harmonic motion - where a vibration fades out as energy is transferred from one object to another.

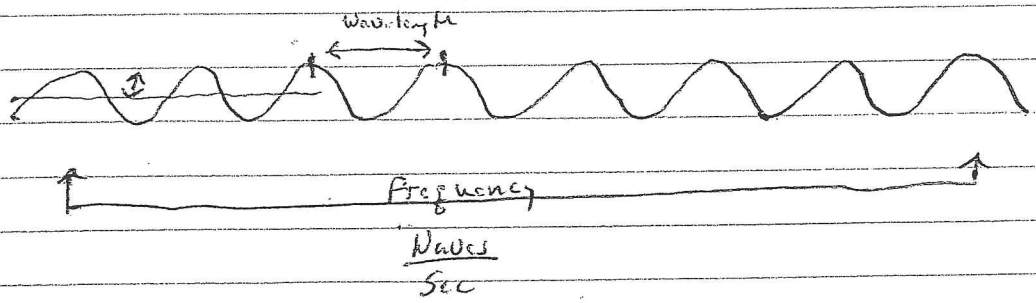
9) Transverse Waves - Wave in which the wave motion is perpendicular to the particle motion.

10) Example

(A)



(B)



11) Wavelength - Distance from the crest of one wave to the next wave. (cm or m units)

12 Frequency - number of waves that passes a given point per second. ($\frac{\text{Waves or Vibrations}}{\text{Sec}}$) = Hz

13) Relationship of Wavelength and Frequency:

$C = \lambda F$

C = Speed of light 3.00×10^8 m/s

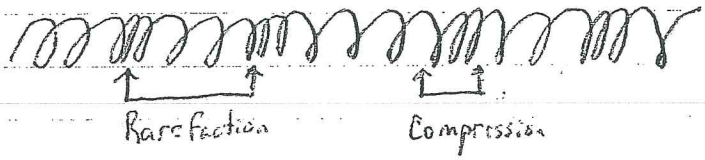
λ = Wavelength m

F = Frequency 1/s

($F = \frac{C}{\lambda}$ or $\lambda = \frac{C}{F}$ Inversely proportional (2))

14) Longitudinal Wave – Waves that cause the particles in a medium to vibrate parallel to the direction of wave motion.

15) Example

(A) 

16) Surface Wave – Wave in which the particles in a surface wave move both perpendicularly and parallel to the direction in which the wave travels.

Example: Ocean waves 

17) Amplitude – distance of .5 from the crest to the trough.

18) Wave height – distance from the crest to the trough.

Note: Amplitude usually applies to the energy in a wave.

(3)

19) Period – 1) time required for one complete vibration.
2) time required for one rise and fall on the ocean.
3) time required for one full wavelength of a wave to pass a certain point.

20) Frequency – number of wavelengths that pass a point in a given time interval.

21) Hertz – (Hz) – SI unit for Frequency F or ν $\frac{\text{waves}}{\text{sec}}$, $\frac{1/\text{s}}{\text{sec}}$

22) Calculation: $\text{Freq} = \frac{1}{\text{period}}$

Note: What is the frequency if a wave crest passes a point every 2 seconds?
period = 2 sec F: _____

$F = \frac{1}{\text{period}} = \frac{1}{2\,\text{sec}} = .5\ \text{Hz}$

23) Wave speed – Wavelength divide by period or Wavelength times frequency.

Note: $V = \lambda F$ V = Velocity
λ = Wavelength
F = Frequency

24) Problem: Green light has a wavelength of 5.20×10^{-7} m. The speed of light is 3.00×10^{8} m/s. What is the frequency of the green light waves?

(4)

24) Continue: $\lambda = 5.20 \times 10^{-7}\ m$ $= 3.00 \times 10^{8}\ m/s$ $F =$ ____

$$\frac{V}{\lambda} = \frac{F\lambda}{\lambda} \qquad F = \frac{V}{\lambda} = \frac{3.00 \times 10^{8}\ m/s}{5.20 \times 10^{-7}\ m} = 5.77 \times 10^{14}\ \frac{1}{s}$$

$$= 5.77 \times 10^{14}\ Hz$$

25) Wave speed medium – Measure of wavespeed based on the medium type solid, liquid or gas.

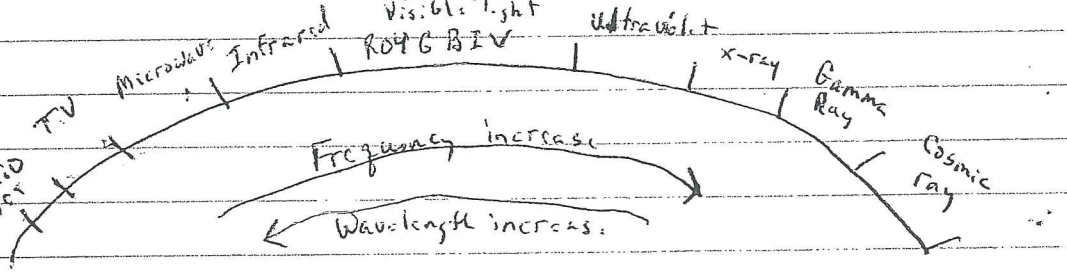
Note: The closer the molecules are to each other the faster energy travels. Fastest solid, liquid, gas
15x20 4x 1

26) Speed of light – $3.00 \times 10^{8}\ m/s$ in a vacuum.

27) Light – Form of energy that is electromagnetic radiation that acts as a wave and a particle like characteristics.

28) Electromagnetic radiation – Form of energy that exhibits wave like behavior as it travels through space.

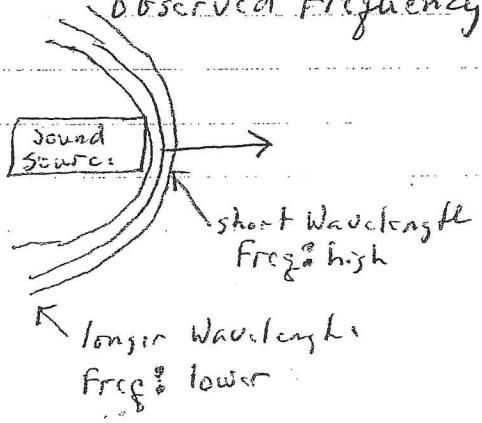
29) Electromagnetic spectrum – all the forms of electromagnetic radiation going from low to high frequency.



(5)

30 Doppler Effect - measure of the effect of motion between the source of waves and the observer creating a change in the observed frequency.

Note:



31) Reflection - bouncing back of a wave when it meets a surface or boundary.

32) diffraction - bending of waves as they pass an edge and is dependent on its wavelength and on the size of the barrier or opening.

33) refraction - bending of waves when they pass from one medium into another.

34) Interference - occurs when several waves are in the same location, they combine to produce a single, new wave that is different from the original waves.

Note: Once these waves pass through each other and move on, they return to the original shape.

(6)

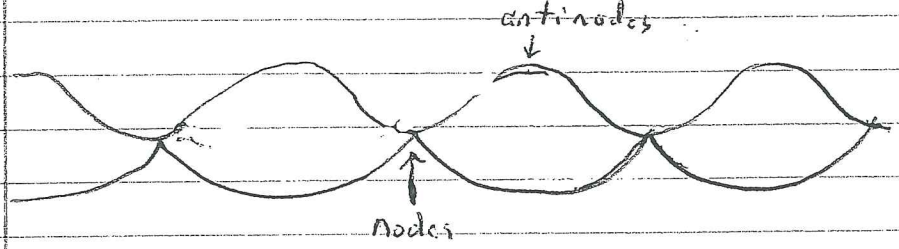
35) Constructive interference - occurs when waves overlap and the results is a wave whose amplitude is the sum of the amplitudes of the two individual waves.

36) destructive interference - occurs when waves overlap and the results is a smaller amplitude than the larger of the two waves.

37) Standing wave - Occurs from the results of interference between a wave and its reflected wave.

38) Node - point where the crest of the original wave meets the trough of the reflected waves. Point of complete destructive interference.

39) Antinode - midway between the nodes lie points of maximum vibration.



(7)

Sound and light

1) Sound waves – caused by vibrations and carry energy through a medium as longitudal waves.

2) Speed of sound – dependant on the matter the sound wave travels through. The closer the particles are to each other the faster it travels.

Note: (Best) Solid → liquid → gas (Worst)

3) Intensity of Sound – loudness of a sound depends on the amplitude of the sound wave.

4) Decibels (dB) – measure of the amplitude of sound.

Note: An increase in intensity of 10 dB seems to double the loudness.

1) Cats purring – 30 dB
2) Vacuum Cleaner – 70 dB
3) Lawn Mower – 90 dB
4) Threshold of Pain – 120 dB

5) Pitch – measure of the frequency of a sound.

6) Infrasound – Sound wave whose frequency is below the range of human hearing

7) Ultrasound – Sound wave whose frequency is above the range of human hearing.

(1)