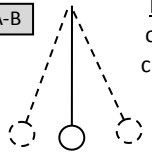
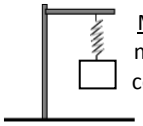
Waves Review Map

5.1.1A-B



Pendulum
only length changes the period

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



Mass on Spring
mass and spring constant change the period

$$T = 2\pi\sqrt{\frac{m}{k}}$$

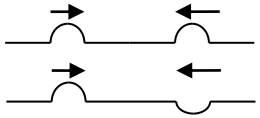
5.1.2A-B

Pulse – a single vibratory disturbance in a medium that carries energy but NOT MASS.

As pulses travel they…
- lose amplitude (energy) due to friction
- maintain the same speed until they reach a new medium

As they enter a new medium…
- speed and amplitude may change
- partly transmitted and partly reflected
  - Amount and direction of reflected energy depends on the difference between the two mediums

When pulses meet in a medium they…
- constructively or destructively interfere



Periodic Wave – a set of regularly repeating pulses

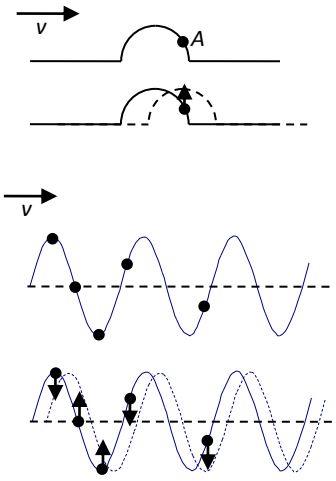
$$v = f\lambda \qquad T = \frac{1}{f}$$

Waves do everything that pulses do but since they repeat they also have:
- frequency – number of repeats per second (Does NOT CHANGE when a wave changes mediums!!!)
- period – time for a cycle to repeat
- wavelength – distance between repeats

Classified by method of production
- Mechanical: disturbance of a medium
- Electromagnetic: Acceleration of charge

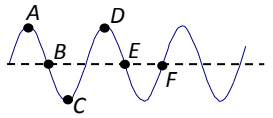
5.1.3E **Motion of Particles**

Draw a new pulse or wave in the direction of wave travel… The particle must rise or fall to meet the new pulse or wave

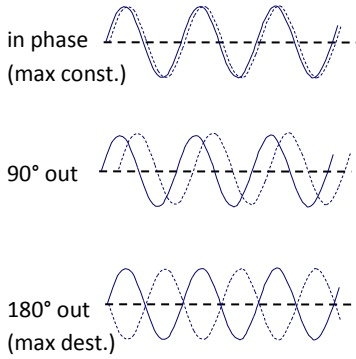


5.1.3D **Phase**

To be "in phase" two points or waves must be "doing the same thing" – same direction of motion and same height.



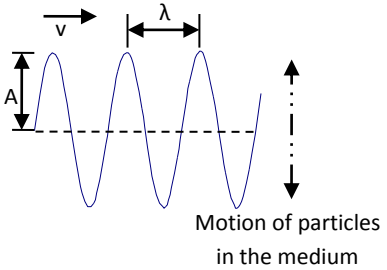
In phase: AD; BE
90° out of phase: AB; BC; DE
180° out of phase: AC; CD; EF



Mechanical Waves - produced by a disturbance in a medium – require a medium – classified by direction of particle motion in the medium

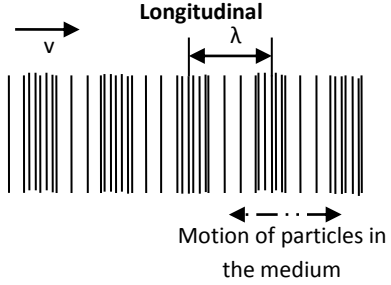
5.1.3B-C

Transverse



Faster in sparse mediums
Can be polarized

Longitudinal



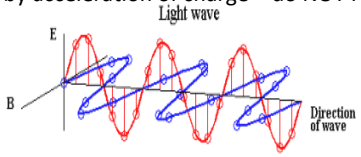
Faster in dense mediums
Cannot be polarized

Wave amplitude is directly related to ENERGY – all waves lose energy as they travel
Amplitude is synonymous with intensity and loudness (in sound)

5.2.1

Electromagnetic Waves

Produced by acceleration of charge – do NOT require a medium



EM Waves are transverse only – travel as perpendicular electric and magnetic fields

Travel at the speed of light – 3×10^8 m/s in a vacuum (slower in denser mediums)

Index of refraction (n) tells relative speed in medium – higher index = lower speed

All parts of the EM Spectrum are transmitted by this type of wave

An EM Wave is classified using the EM Spectrum Chart

High f = Short λ ---------- Low f = Long λ
Gamma -----X-Ray ----- Ultraviolet ----- Visible ----- Infrared ----- Microwaves ----- Radio
[------IONIZONG RADIATION--------] Non-ionizing radiation

Wave Phenomenon

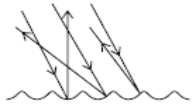
ALL TYPES of waves and pulses are subject to the following set of phenomenon

Waves that encounter boundaries will partly REFLECT

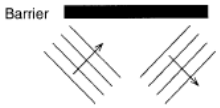
5.1.6A
5.2.2A

Reflection

When a wave hits a surface at least SOME of its energy is always reflected.



Diffuse Reflection



Regular Reflection

$\theta_i = \theta_r$

As waves travel they may be bent for different reasons.

If a wave bends because of changes in speed it is called REFRACTION. $n = \frac{c}{v}$ $\frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$

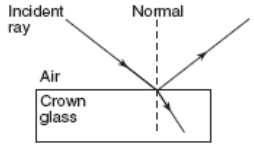
If a wave bends because it is passing around a barrier it is called DIFFRACTION

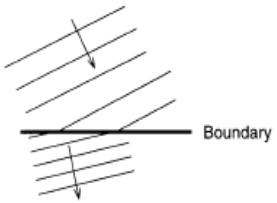
5.1.6B
5.2.2B

Refraction

When a wave enters a new medium its speed and direction may change

$n_1 \sin\theta_1 = n_2 \sin\theta_2$





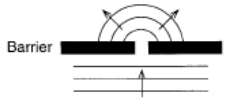
5.1.6C
5.2.2C

Diffraction

Bending of wave fronts and wave rays around barriers and through openings

$\lambda >>$ opening → lots of diffraction

$\lambda \leq$ opening → little diffraction

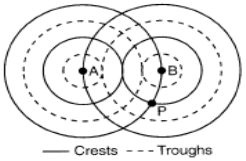


When reflected back, the original wave and the reflected one will INTERFERE

5.1.4A

Interference

May be constructive or destructive



The frequency of a wave does not change once it is produced, however an observer may see an "apparent" change in the frequency of a source if there is relative motion between the source of the wave and the observer.

5.1.5B-C

Doppler Effect

Apparent shift in the frequency of a source or observer due to relative motion of the source and/or observer

Getting closer at a constant speed → constant, higher frequency
Getting closer at increasing speed → increasing, higher frequency
Getting closer at decreasing speed → decreasing, higher frequency

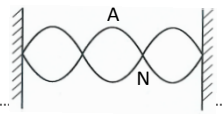
Getting farther at a constant speed → constant, lower frequency
Getting farther at increasing speed → decreasing, lower frequency
Getting farther at decreasing speed → increasing, lower frequency

When two waves with the same amplitude, frequency, and period interfere we get STANDING WAVES

5.1.4B

Standing Waves

Result of reflection combining with interference – two waves moving in opposite directions with same frequency and amplitude



<u>node</u> – destructive (always 180° out of phase)

<u>anti-node</u> – maximum motion

5.1.4C

Resonance

Standing waves produced at or near a medium's natural frequency.