Waves Review Checklist

5.1.1 – Oscillating Systems

5.1.1A – Explain the relationship between the period of a pendulum and the factors involved in building one

Four pendulums are built as shown in the table below:

Pendulum	Mass	Length
A	M	L
B	2M	L
C	M	2L
D	2M	2L

Which statements below are true?

(a) Pendulums A and B have the same period.
(b) Pendulums A and C have the same period.
(c) Pendulums C and D have the same period.
(d) Pendulums B and D have the same period.
(e) Pendulum A has a shorter period than pendulum B.
(f) Pendulum A has a shorter period than pendulum C.

5.1.1B – Explain the relationship between the period of a mass oscillating on a spring and the factors involved in building one

Four masses are hung on four springs as shown in the table below:

System	Mass	Spring Constant
A	M	k
B	M	2k
C	2M	k
D	2M	2k

Which statements below are true?

(a) Systems A and B have the same period.
(b) Systems A and C have the same period.
(c) Systems A and D have the same period.
(d) System A has the shortest period.
(e) System B has the shortest period.
(f) System C has the shortest period.

5.1.2 – Pulses

5.1.2A – Explain the definition of a pulse

Which of the following is transmitted by a pulse?
(1) energy and mass
(2) mass only
(3) energy only

The energy contained in a pulse is related to its:
(1) amplitude and speed (3) width and speed
(2) amplitude only (4) speed only

As pulses travel they lose:
(1) amplitude and speed (3) width and speed
(2) amplitude only (4) speed only

5.1.2B – Explain reflection and superposition of pulses

A pulse moves from a very thick rope into a thin string. Circle the term that makes the statement true.

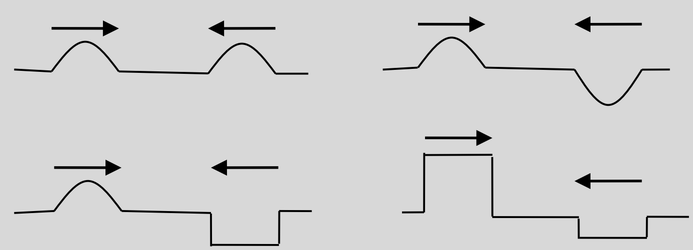
(a) The transmitted pulse will lose / gain amplitude.

(b) The transmitted pulse will lose / gain speed.

(c) The transmitted pulse will lose / gain energy.

(d) The reflected pulse will / will not come back on the opposite side.

Sketch the superposition of the following sets of pulses.



5.1.3 – Wave Properties

5.1.3A – Use equations to determine wave speed, wavelength, period, or frequency

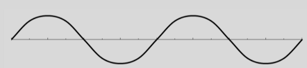
What is speed of a wave with a frequency of 10 hertz if its wavelength is 3 meters?

What is the wavelength of a wave with a frequency of 6 hertz if it is moving at 30 meters per second?

What is the frequency of a wave that is moving at 15 meters per second if its wavelength is 7.5 meters? What is this wave's period?

5.1.3B – Understand the difference between longitudinal and transverse waves.

Mark each diagram or statement with a "T" if it describes a transverse wave or an "L" if it describes a longitudinal wave.



Particles in this type of wave move parallel to the direction of wave travel.

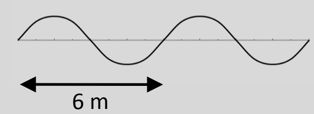
Particles in this type of wave move perpendicular to the direction of wave travel.

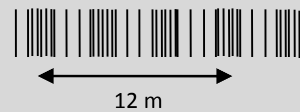
This wave moves more quickly in dense mediums than sparse ones.

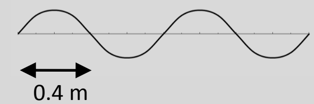
This wave moves more quickly in sparse mediums than dense ones.

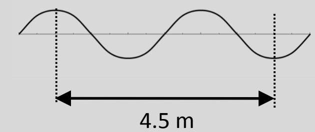
5.1.3C – Explain how amplitude and wavelength are measured.

What is the wavelength of each of the waves shown below?

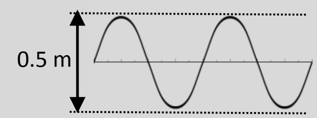


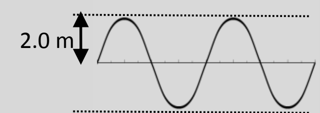






What is the amplitude of each of the waves shown below?

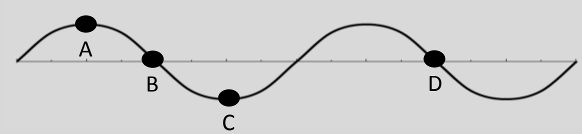




5.1.3D – Explain the concept of 'phase'.

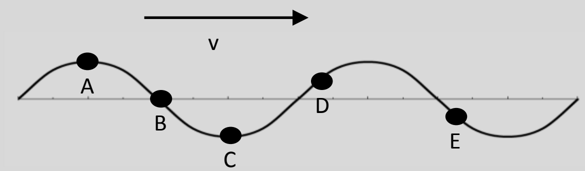
Pick a set of points that are:

(a) in phase (b) 90° out of phase (c) 180° out of phase



5.1.3E – Explain the direction of particle motion in a medium.

Determine the direction in which each particle shown in the diagram will move in the next instant of time if the wave moves to the right.



In which type of wave will particles move north and south if the wave travels east to west?

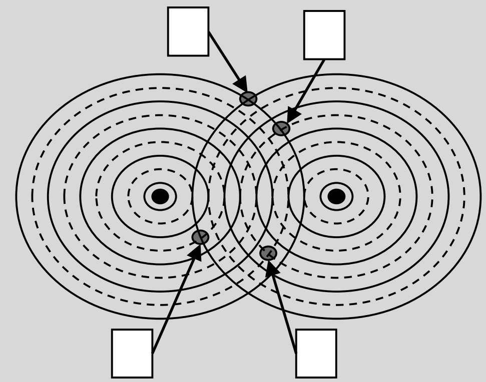
(1) longitudinal (3) circular
(2) transverse (4) torsional

How will particle A move in the wave shown below?

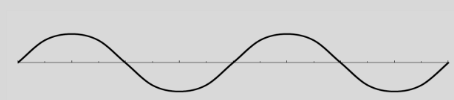
5.1.4 – Interference, Standing Waves, and Resonance

5.1.4A – Explain the phenomenon of wave interference.

Two point sources produce a pattern of overlapping circular waves. The solid lines in the diagram represent wave crests while the dotted lines represent wave troughs. Mark a "C" in the boxes that inidcate constructive interference and a "D"in the boxes that indicate destructive interference.



Sketch a wave that will completely destructively interfere with the wave shown below. What is the phase difference between these two waves?



At the point when the two waves shown below completely overlap, what will the superposition of the two waves look like? Draw a sketch of the wave produced during this interaction.

5.1.4B – Explain the origin of and describe features of standing waves.

A standing wave is produced as a result of a combination of

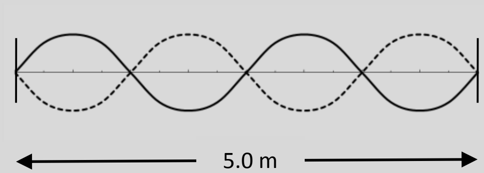
___________________ and ______________________.

The main features of standing waves are:

______________________ at which minimum motion of the medium occurs.

_______________________ at which maximum motion of the medium occurs.

Determine the wavelength of the standing wave shown below. Identify one node and one anti-node.



A _________________ is the result of a constant 180° phase difference between two waves passing through each other.

To produce a standing wave, two waves must:

- be moving in _______________________________
- have the same:
  - _____________________________
  - _____________________________
  - _____________________________

5.1.4C – Explain the phenomenon of resonance.

Resonance occurs when an object is made to vibrate with its

_____________________________________.

Give two examples of systems in which resonance occurs.

<u>5.1.5 – Sound and Doppler Effect</u>

5.1.5A – Explain the origin of sound waves, the conditions necessary for them to exist and details regarding their transmission.

Circle the terms that properly complete the sentences below.

Sound is transmitted as a <u>TRANSVERSE / LONGITUDINAL</u> wave.

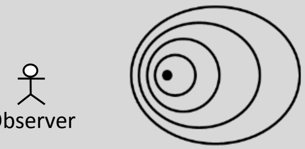
Sound is produced as a(n) <u>MECHANICAL / ELECTROMAGNETIC</u> wave.

Sound travels more <u>QUICKLY / SLOWLY</u> in water than it does in air. Explain why this is true!

A 440 hertz sound wave is sent from a transmitter and bounced from a wall that is 100 meters away. Determine the time that it takes for the wave to return after it is transmitted. (Note: speed of sound in air = 3.31×10^2 m/s)

5.1.5B – Explain the motion of objects in Doppler Effect diagrams.

The diagram below shows a source of sound waves moving with a constant speed near an observer. The source produces sound waves with a frequency of 100 hertz. Is the source getting closer to the observer or farther away?



Which frequencies *could* the observer be hearing as the source approaches?

(a) 80 Hz (b) 100 Hz (c) 110 Hz (d) 120 Hz

As the source approaches, will the frequency heard by the observer be constant, increasing, or decreasing?

5.1.5C – Explain frequency changes due to the Doppler Effect.

A train is moving at a constant 35 meters per second away from an observer. As the train is moving it blasts its horn which produces a sound with a frequency of 1000 hertz. The observer will perceive that the horn's frequency is

(1) less than 1000 hertz and constant
(2) less than 1000 hertz and decreasing
(3) greater than 1000 hertz and constant
(4) greater than 1000 hertz and increasing

A police car is accelerating toward an observer. The police car's siren produces a sound with a frequency of 1200 hertz. The observer will perceive that the siren's frequency is

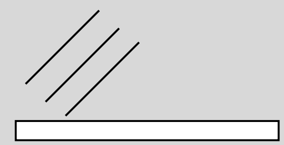
(1) less than 1200 hertz and constant
(2) less than 1200 hertz and decreasing
(3) greater than 1200 hertz and constant
(4) greater than 1200 hertz and increasing

5.1.6 – Reflection, Refraction, Diffraction

5.1.6A – Describe the phenomenon of reflection; identify and sketch wave front diagrams in which reflection occurs.

When waves encounter a change in medium or a barrier, some of the energy is always ____________________ and some is always _____________________.

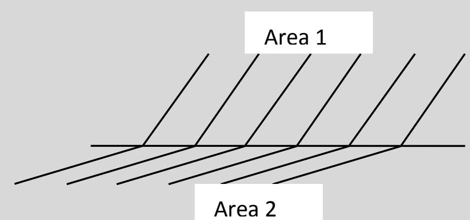
The diagram below shows a series of wave fronts approaching a barrier. Sketch a set of reflected wave fronts on the diagram.



5.1.6B – Explain why waves refract; identify and sketch wave front diagrams in which refraction occurs.

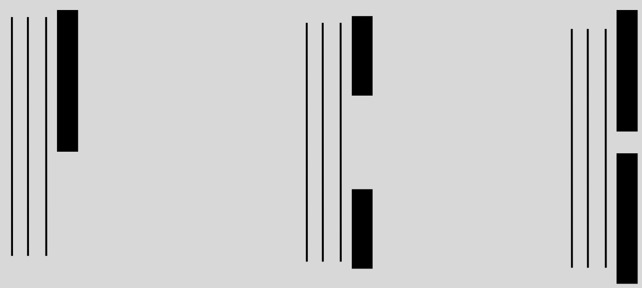
Waves refract when they change ____________________.

In which area of the diagram below is the wave traveling more quickly?



5.1.6C – Explain the diffraction of waves. Identify and sketch wave front diagrams in which diffraction occurs.

Waves are diffracted as they pass through openings or around barriers. Sketch the diffraction pattern in each of the three cases shown below. In which case is the diffraction most pronounced?



5.2.1 – EM Spectrum and EM Waves

5.2.1A – Determine the part of the EM Spectrum that a particular wave belongs to.

What type of electromagnetic radiation is a wave with a ________________?

wavelength of...

- (a) 3.5×10^3 meters
- (b) 4.5×10^{-8} meters
- (c) 2.0×10^{-12} meters
- (d) 6.0 meters

frequency of...

- (a) 3.0×10^6 hertz
- (b) 2.2×10^{15} hertz
- (c) 1.5×10^{10} hertz
- (d) 5.5×10^{14} hertz

5.2.1B – Explain the origin of electromagnetic waves and contrast this with the production of mechanical waves.

Electromagnetic waves can be produced by which of the following? Which would produce a mechanical wave?

- (1) An electron moving at a constant velocity
- (2) A plastic slinky vibrating back and forth
- (3) An electron oscillating back and forth
- (4) A neutron oscillating back and forth
- (5) A string with a single disturbance moving through it
- (6) A positively charged sphere vibrating back and forth

5.2.1C – Use equation to determine speed in a medium or index of refraction for a medium.

Determine the speed of a ray of light with a frequency of 5.09×10^{14} hertz as it passes through water (index of refraction = 1.33).

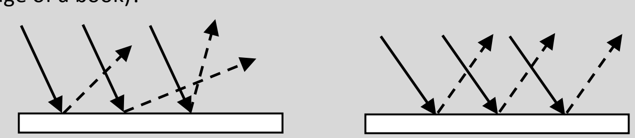
Determine the absolute index of refraction for a medium in which microwaves travel at a speed of 1.8×10^8 meters per second.

5.2.2 – EM Wave Phenomenon

5.2.2A – Explain the Law of Reflection; identify the two types of reflection; and identify ray diagrams in which reflection occurs.

The Law of Reflection states that the angle at which anything is reflected is equal to the ____________________________ with which it hits a surface.

Which of the following pictures showsn light hitting a highly reflective surface (like a mirror)? Which type occurs on a surface that is not highly reflective (like the page of a book)?

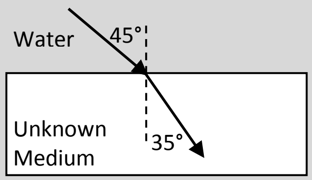


Diffuse Reflection   Specular/Regular Reflection

5.2.2B – Explain Snell's Law and identify ray diagrams in which refraction occurs. Use Snell's Law to determine angle of incidence; angle of refraction; or index of refraction.

A ray of light moving from air (n = 1) into Lucite (n = 1.5) enters the Lucite at an angle of 35° relative to a line perpendicular to the Lucite surface. What angle will the light be bent at as it moves through the Lucite?

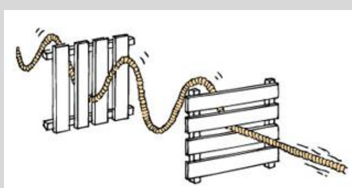
The diagram below shows a ray of light moving from water into an unknown medium. Determine the index of refraction of the unknown medium.



Polarization

5.2.2C – Explain the phenomenon of polarization and recognize diagrams showing that polarization is occurring.

The diagram below shows a set of polarizers acting on a wave. What is the end product of having two polarizers set at 90° relative to one another?



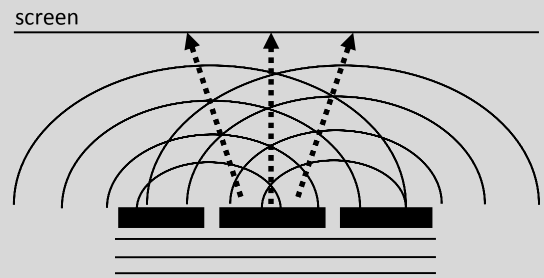
Which types of waves can be polarized?

(1) mechanical, transverse waves
(2) mechanical, longitudinal waves
(3) electromagnetic, transverse waves

Wave Nature of Light

5.2.2D – Explain how Young's Double Slit Experiment demonstrates that light has a wave nature.

The diagram below shows light passing through two slits. What will occur at the points at which the arrows in the diagram hit the screen? (Note the type of interference occurring at the points where the wave-fronts overlap along these lines!)



Which of these phenomena show that light has a wave nature? (There may be more than one!)

(1) Reflection
(2) Interference
(3) Doppler Effect
(4) Refraction
(5) Polarization
(6) Diffraction