



PHYSICS 2204
Unit 4: Waves
Worksheet #1: Introduction to Waves

Student Name: _____

Wave can be described as the transfer of energy, in a form of a disturbance that travels through a medium from one location to another location.

Waves are classified by what they move through :

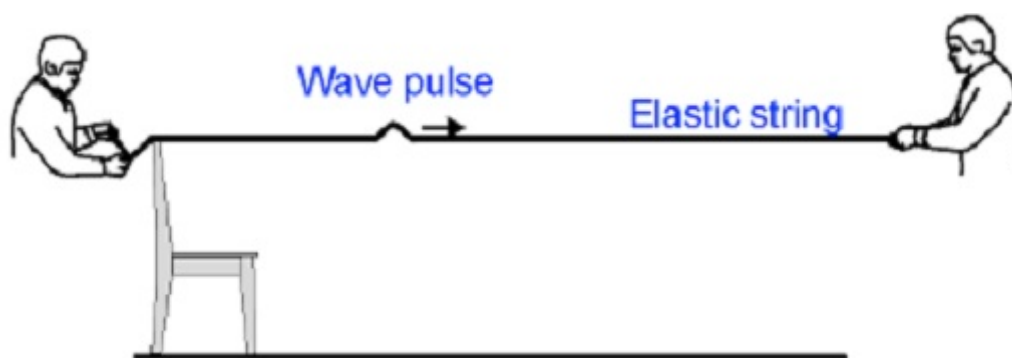
1) Mechanical Waves:

The energy is transferred by vibrations of **medium** (medium is a substance or material which carries the wave) Example: Sound

2) Electromagnetic waves (EM Waves):

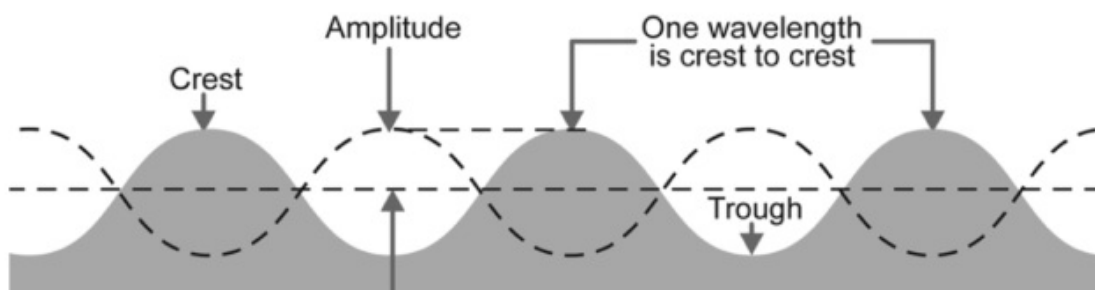
the energy moves through disturbances in the electromagnetic field. Can travel through a vacuum. Example Light

Wave pulse is a short length of wave, often just a single oscillation



One way to categorize waves is on the basis of the direction of movement of the individual particles of the medium relative to the direction which the waves travel

1) Transverse waves: Waves in which the medium moves at right angles to the direction of the wave



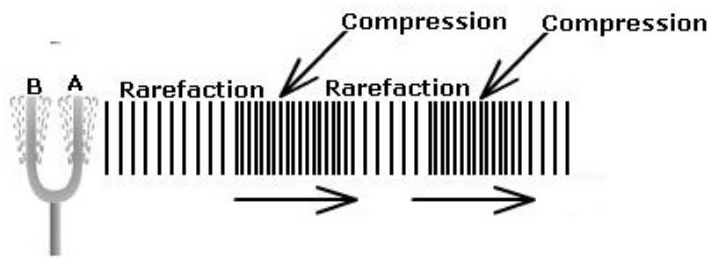
Crest : A high point of a wave.

Trough A low point of a wave.

Amplitude half the distance from a crest to a trough.

Wavelength The distance from one crest to the next is called the. Wavelength can also be measured from trough to trough or from any point on the wave to the next place where that point occurs.

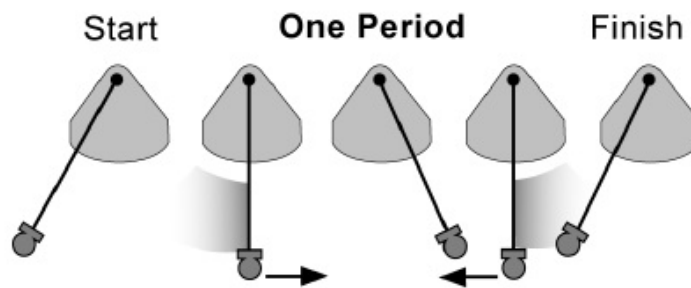
2) **Longitudinal wave**



Compression: where the particles are close together

Rarefaction: where the particles are spread apart

Consider the Pendulum below



Period of a pendulum is the time it takes to move through one cycle. As the ball on the string is pulled to one side and then let go, the ball moves to the side opposite the starting place and then returns to the start. This entire motion equals one cycle. It is measured in seconds. It can be calculated using the formula:

$$Period = \frac{Time}{\#cycles}$$

Frequency is a term that refers to how many cycles can occur in one second. For example, the frequency of the sound wave that corresponds to the musical note “A” is 440 cycles per second or 440 hertz. The unit hertz (Hz) is defined as the number of cycles per second. Hz may also be written as /s or s-1.

$$frequency = \frac{\#cycles}{time}$$

The terms period and frequency are related by the following equation:

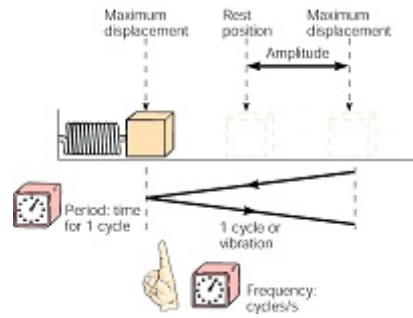
$$\begin{array}{c}
 \text{Frequency (hertz)} \\
 \downarrow \\
 \text{Period (seconds)} \rightarrow \mathbf{T} = \frac{1}{\mathbf{f}} \quad \mathbf{f} = \frac{1}{\mathbf{T}} \leftarrow \text{Period (seconds)} \\
 \text{Frequency (hertz)} \rightarrow \mathbf{f}
 \end{array}$$

Example 1:

A block in simple harmonic motion completes 20 cycles in 5.0 s.

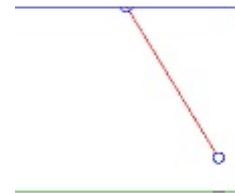
A) Determine the period:

B) Calculate the frequency



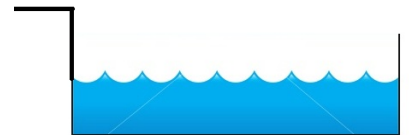
Example 2:

A pendulum has a period of 0.3 second. What is its frequency?



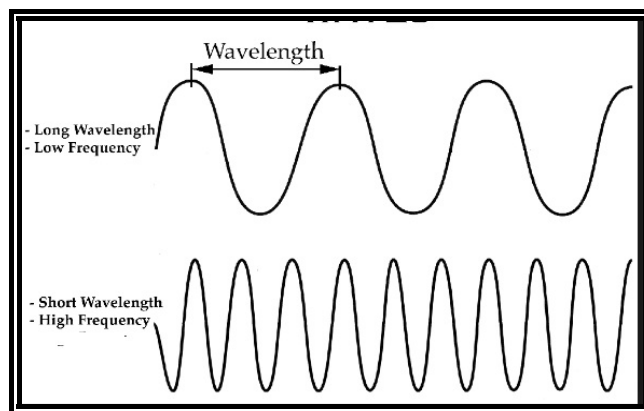
Example 3:

If 10 waves pass one dock every 16.0 seconds, determine the period and frequency of the wave:



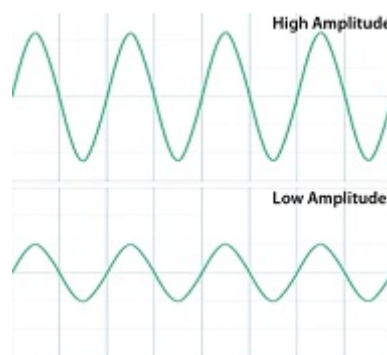
Wavelength and Frequency Relationship

The wavelength and frequency of waves are closely related. The higher the frequency, the shorter the wavelength.



Amplitude and Frequency Relationship

Amplitude is merely the 'size' of the wave. So, two signals with different amplitudes, can have the same frequency (and hence wavelength).



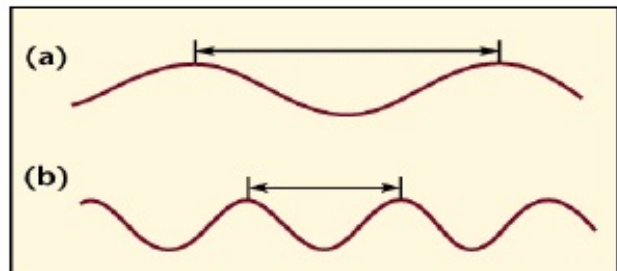
PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. What do waves transfer ?
 - (A) Energy only
 - (B) Energy and matter
 - (C) Matter only
 - (D) Neither energy nor matter
2. Which of the following types of waves requires a medium?
 - (A) Microwaves
 - (B) Sound waves
 - (C) Visible light
 - (D) X-rays
3. What is the unit for wavelength?
 - (A) Hertz
 - (B) Meter
 - (C) Newton
 - (D) Wavelength

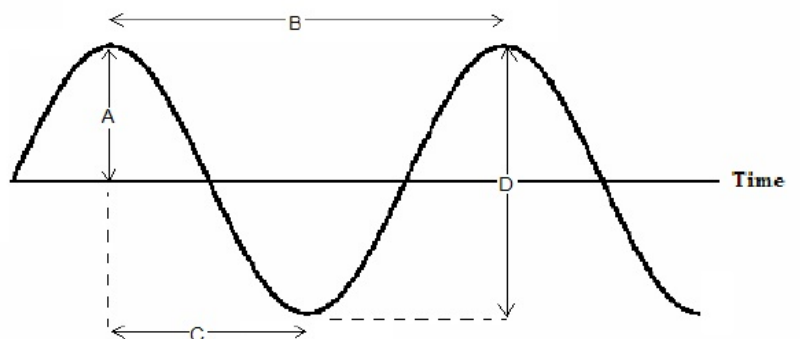
4. What does the arrows in (a) and (b) - identified in the illustration below?

- (A) Amplitude
- (B) Crest
- (C) Rest position
- (D) Wavelength

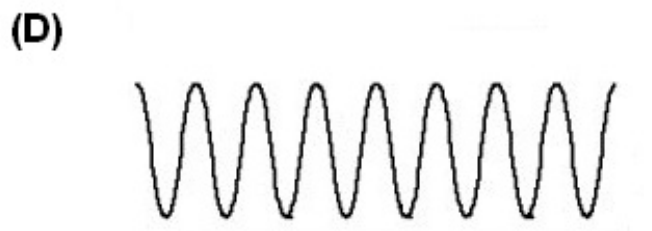
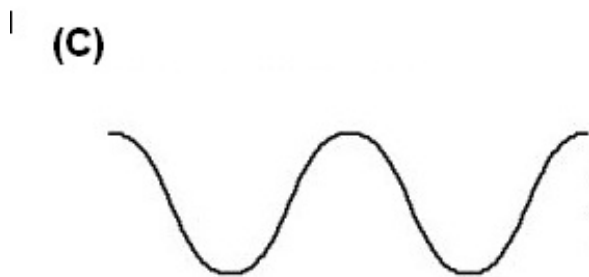
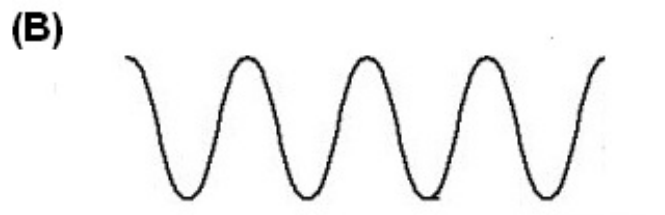


5. Which of the following accurately describes a wavelength?
 - (A) From equilibrium to amplitude
 - (B) From equilibrium to crest
 - (C) From crest to trough
 - (D) From crest to crest
6. Which is the time required for a wave to complete one full cycle?
 - (A) Amplitude
 - (B) Frequency
 - (C) Period
 - (D) Wavelength
7. Which represents wavelength in the diagram shown?

- (A) A
- (B) B
- (C) C
- (D) D



8. What type of mechanical wave has particle motion in the same direction as energy transfer?
- (A) Infrared
 (B) Longitudinal
 (C) Transverse
 (D) Ultrasonic
9. If a boat is traveling over a wave with amplitude of 6 m, how far does it fall when moves from crest to trough?
- (A) 0 m
 (B) 6 m
 (C) 12 m
 (D) 18 m
10. A transverse wave is moving from left to right. In which direction will a particle at the crest of the wave move next?
- (A) Down
 (B) Left
 (C) Right
 (D) Up
11. Which of the following waves has the highest frequency



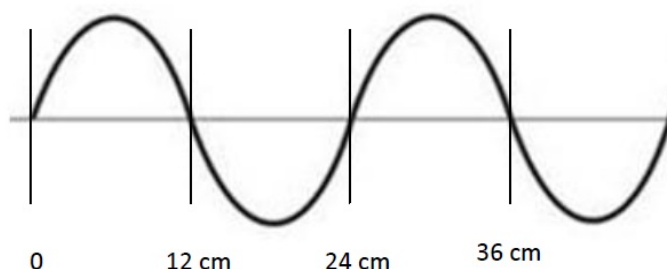
12. Which represents a transverse wave with the longest wavelength?



13. Assuming that the speed of a wave stays the same, what must happen for the frequency of the wave to decrease?
- (A) The amplitude must decrease
 - (B) The amplitude must increase
 - (C) The wavelength must increase
 - (D) The wavelength must decrease

14. What is the wavelength of the wave shown below?

- (A) 6.0 cm
- (B) 12 cm
- (C) 24 cm
- (D) 36 cm



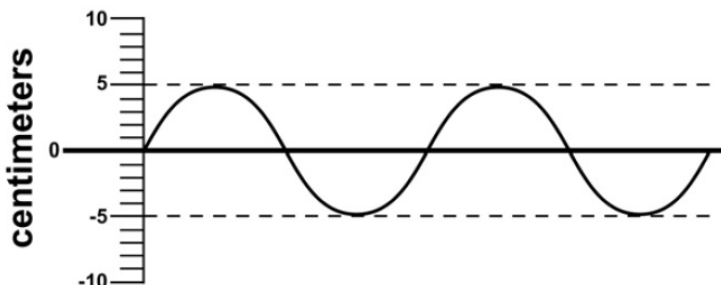
15. What is the unit for frequency?
- (A) Hertz
 - (B) Metre
 - (C) Newton
 - (D) Wavelength
16. A fly flaps its wings back and forth 150 times each second. What is the frequency of a wing flap for the fly?
- (A) 0.0067 Hz
 - (B) 0.040 Hz
 - (C) 2.5 Hz
 - (D) 150 HZ
17. A bored swimmer on an air mattress begins counting wave crests that pass underneath her air mattress. If she counts 4 crests, how many wavelengths passed underneath while she was counting?
- (A) 2 wavelengths
 - (B) 3 wavelengths
 - (C) 4 wavelengths
 - (D) 5 wavelengths
18. A swimmer on an inner tube bobs over waves in the water after a large ship passes by. If 2 seconds elapse between each bob of the swimmer upward, what is the frequency of the water waves?
- (A) 0.5 Hz
 - (B) 1 Hz
 - (C) 1.5 Hz
 - (D) 2 Hz
19. A buoy bobs up and down on the ocean a total of 12 times in 6.0 seconds. What is the frequency of the motion?
- (A) 0.50 Hz
 - (B) 2.0 Hz
 - (C) 12 Hz
 - (D) 72 Hz

20. A student counts 8 waves hitting the beach in 22 s. What is the period of the waves?
- (A) 0.36 s
 (B) 2.8 s
 (C) 22 s
 (D) 180 s

PART B: WRITTEN RESPONSE

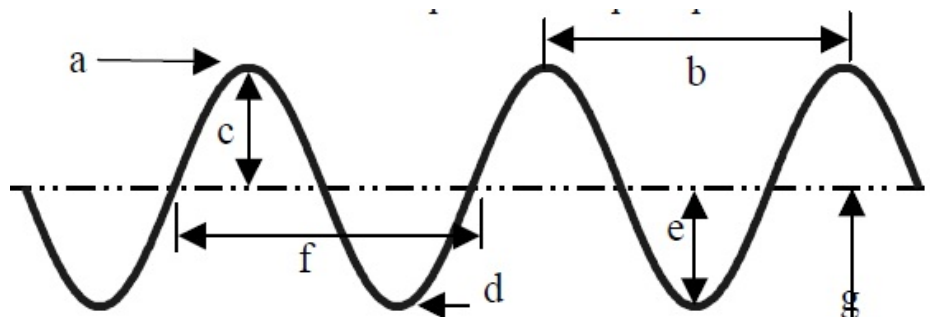
1. On the illustration to the right label the following parts of a wave:

- one wavelength,
- half of a wavelength
- the amplitude,
- a crest,
- a trough.



- A) How many wavelengths are represented in the wave above?
 B) What is the amplitude of the wave shown above?

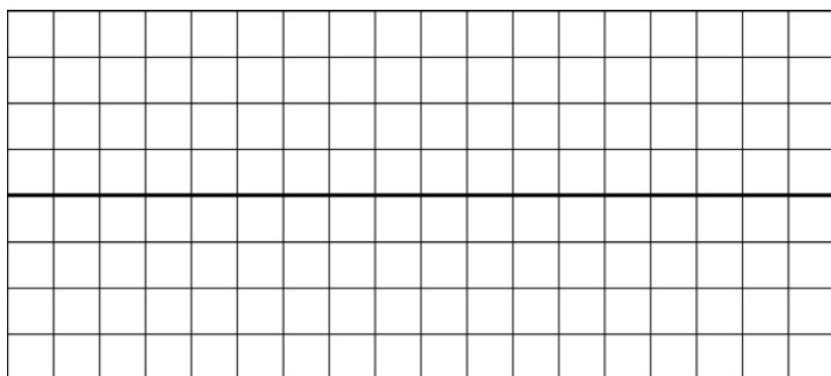
2. The illustration below shows a series of transverse waves. Label each part in the space provide d.



- A) _____
 B) _____
 C) _____
 D) _____
 E) _____
 F) _____
 G) _____

3. Use the grids below to draw the following waves. Be sure to label the y-axis to indicate the measurement scale.

- A) A wave with an amplitude of 1 cm and a wavelength of 2 cm
 B) A wave with an amplitude of 1.5 cm



4. A string vibrates at a frequency of 20 Hz. What is its period?
5. A speaker vibrates at a frequency of 200 Hz. What is its period?
6. A swing has a period of 10 seconds. What is its frequency?
7. A pendulum has a period of 0.3 second. What is its frequency?
8. You want to describe the harmonic motion of a swing. You find out that it take 2 seconds for the swing to complete one cycle. What is the swing's period and frequency?
9. An oscillator makes four vibrations in one second. What is its period and frequency?
10. A pendulum takes 0.5 second to complete one cycle. What is the pendulum's period and frequency?
11. A pendulum takes 10 seconds to swing through 2 complete cycles.
 - A) How long does it take to complete one cycle?
 - B) What is its period?
 - C) What is its frequency?
12. An oscillator makes 360 vibrations in 3 minutes.
 - A) How many vibrations does it make in one minute?
 - B) How many vibrations does it make in one second?
 - C) What is its period in seconds?
 - D) What is its frequency in hertz?