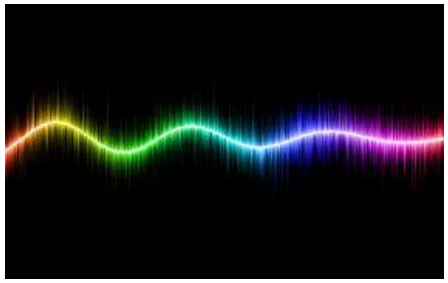
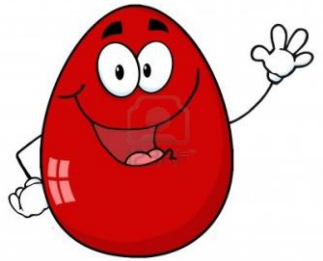
17.2 - Waves





Waves

Mechanical Waves

A disturbance in matter that carries energy from one place to another.

Medium

The material through which a wave travels.

- **Medium can be any three states of matter: solid, liquid or gas**

Waves

When is mechanical wave created?

When a source of energy causes a vibration to travel though a medium.

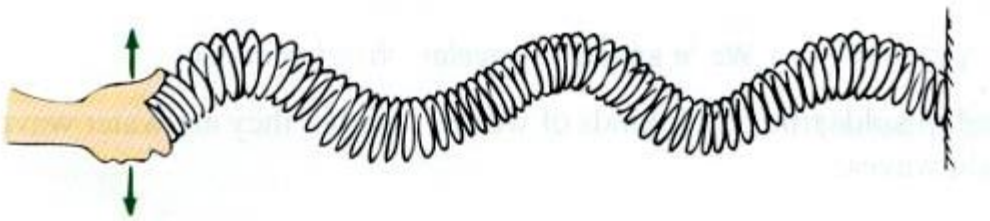
The three types of mechanical waves are:

1. **Transverse Wave**
2. **Longitudinal Waves**
3. **Surface Waves**

Transverse Waves

Transverse Waves

A wave that causes the medium to vibrate at right angles to the direction in which the waves travels.



Crest

The highest point of the wave above the rest position.

Trough

The lowest point of the wave below the rest position.

Transverse Waves

Transverse Waves Examples:

1. Shaking the end of a rope up and down
2. Shaking one end of the blanket up and down
3. Wave in the ball park

Longitudinal Waves

Longitudinal Waves

A wave in which the vibration of the medium is parallel to the direction to the direction the waves travel.

Compression

An area where the particles in a medium are spaced close together.

Rarefaction

An area where the particles in a medium are spread out.

Longitudinal Waves

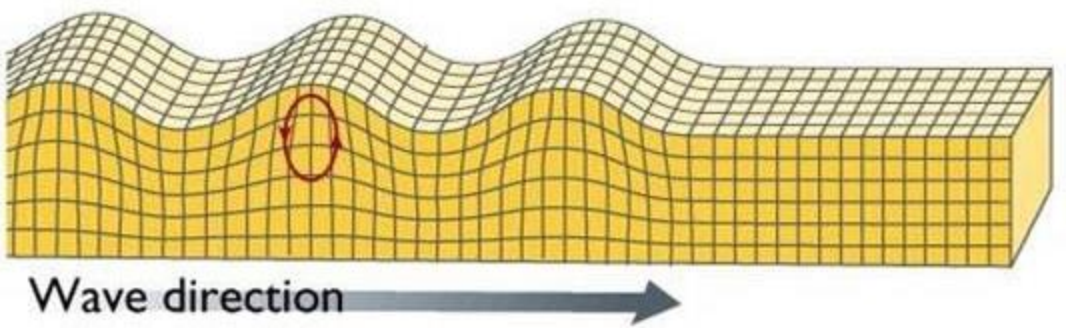
Longitudinal Waves Examples:

1. Waves produced by earthquakes
2. Sound Waves
3. Ultrasound

Surface Waves

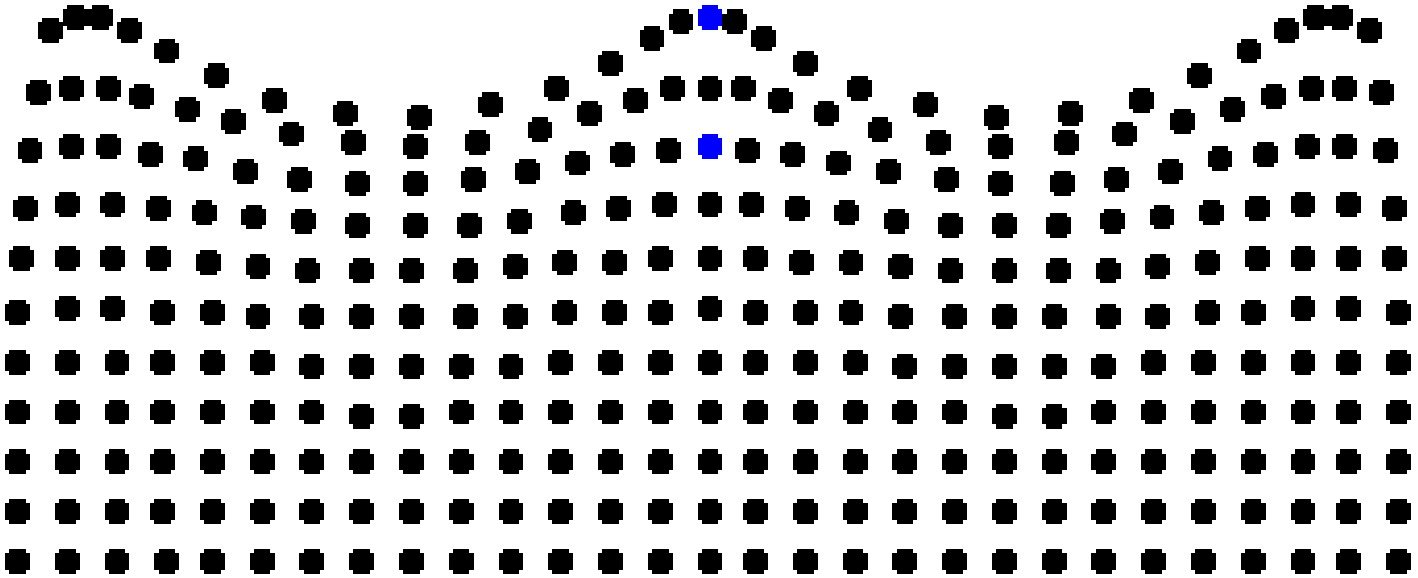
Surface Waves

A wave that travels along a surface separating two media.



- **A surface wave transports an object in a circular motion.**

Surface Waves



Surface Waves

Surface Waves Examples:

1. Ocean Waves
2. A fishing bobber floating

Properties of Mechanical Waves

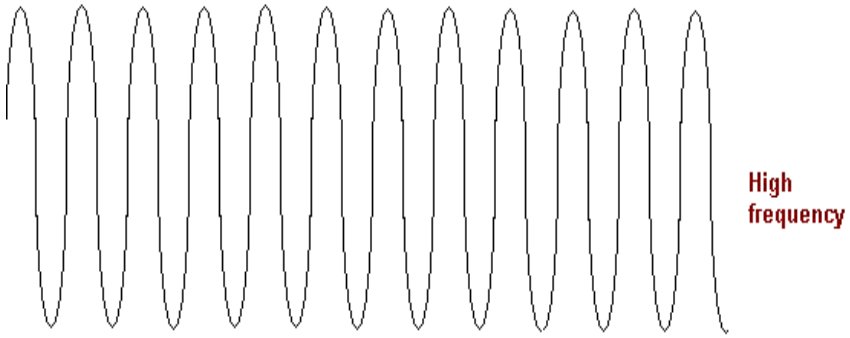
Period Motion

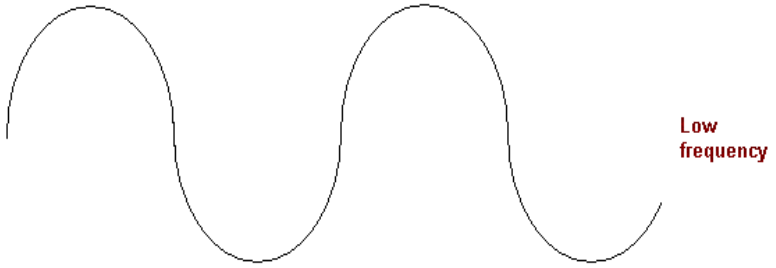
Any motion that repeats at regular time intervals

Frequency

Number of complete cycles in a given time

- Frequency is measured in Hertz (Hz)

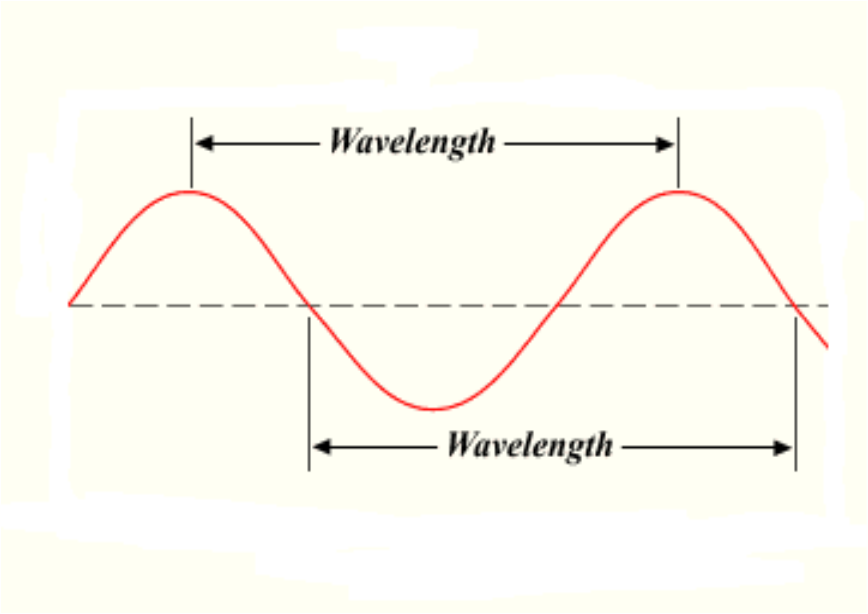




Properties of Mechanical Waves

Wavelength

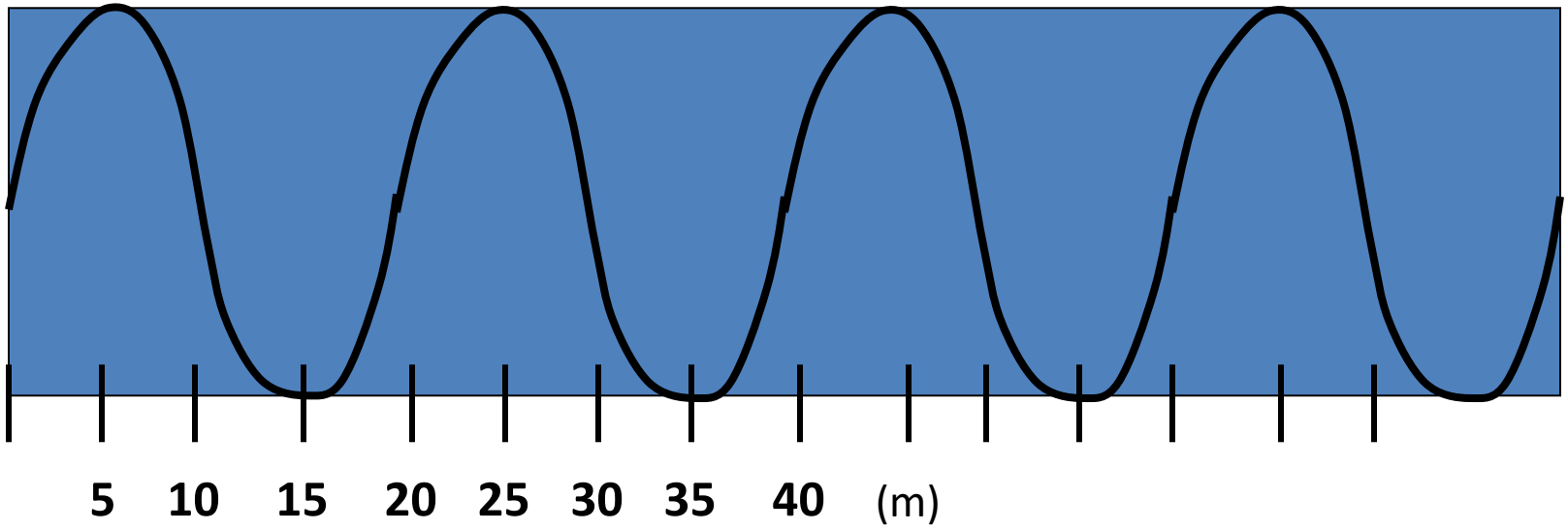
The distance between a point on one wave and the same point on the next cycle of the wave.



Wavelength

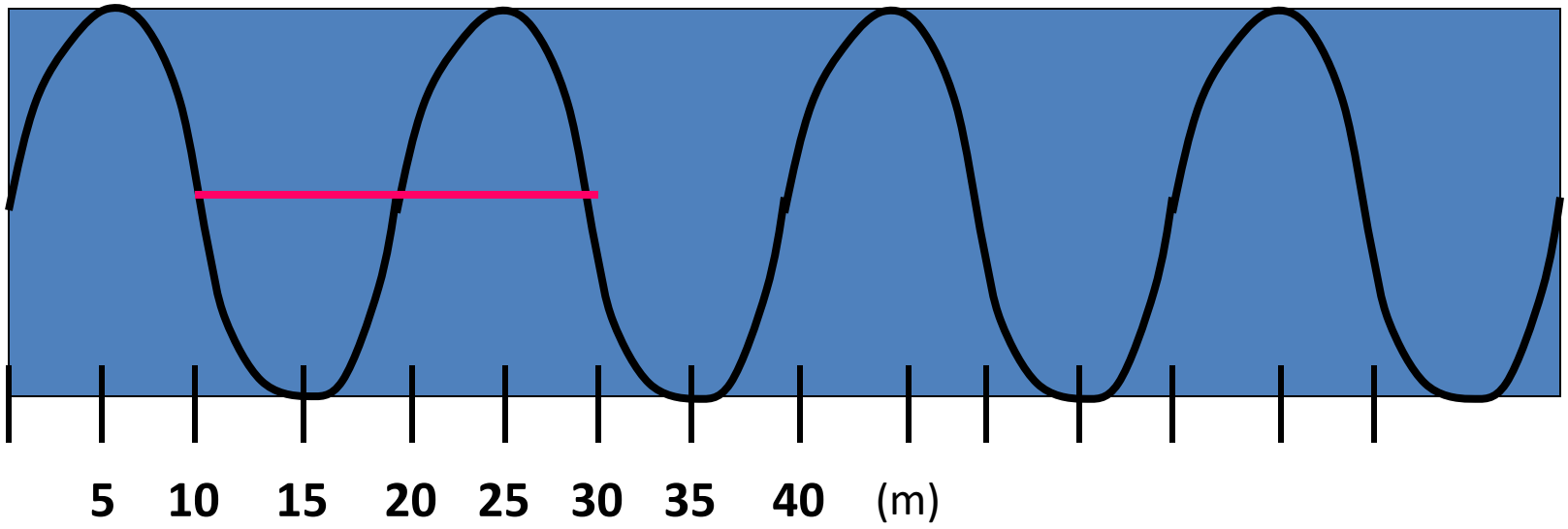
How to find wavelength Distance

- Measure from any identical two successive points



What is the wavelength

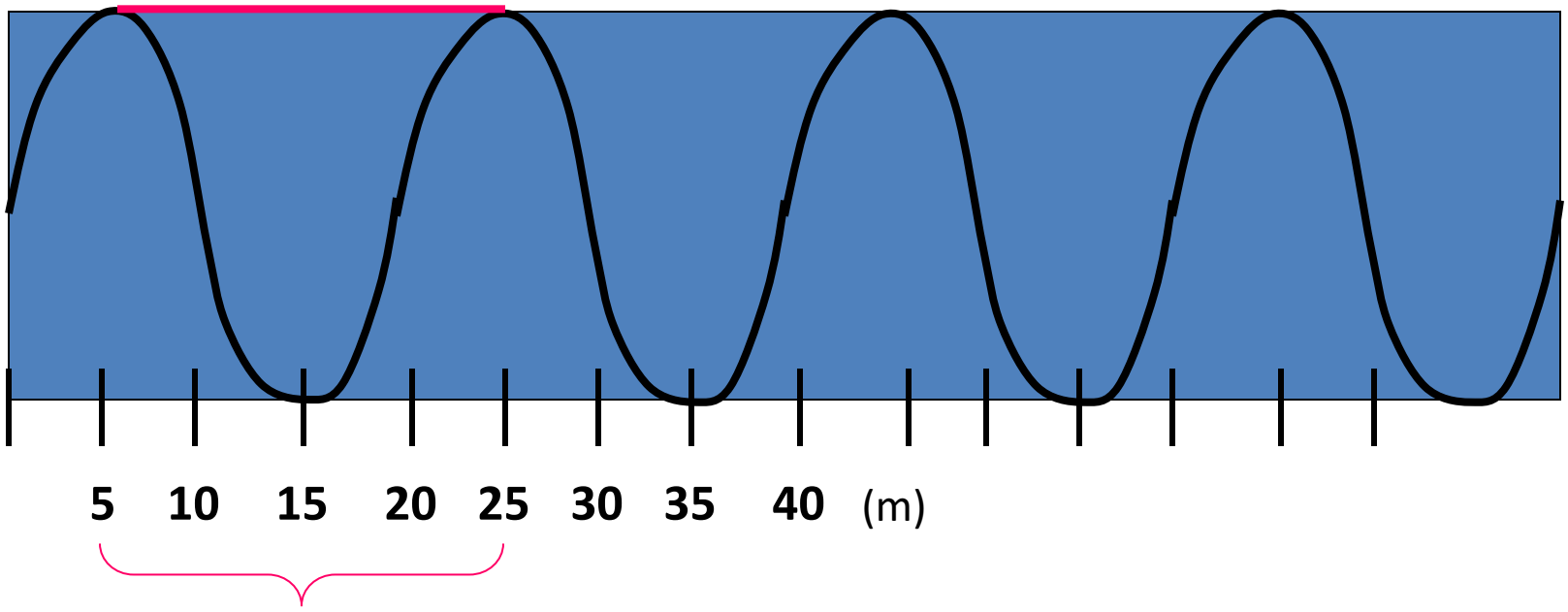
- **Measure from any identical two successive points**



30m – 10m = 20m

What is the wavelength

- **Measure from any identical two successive points**

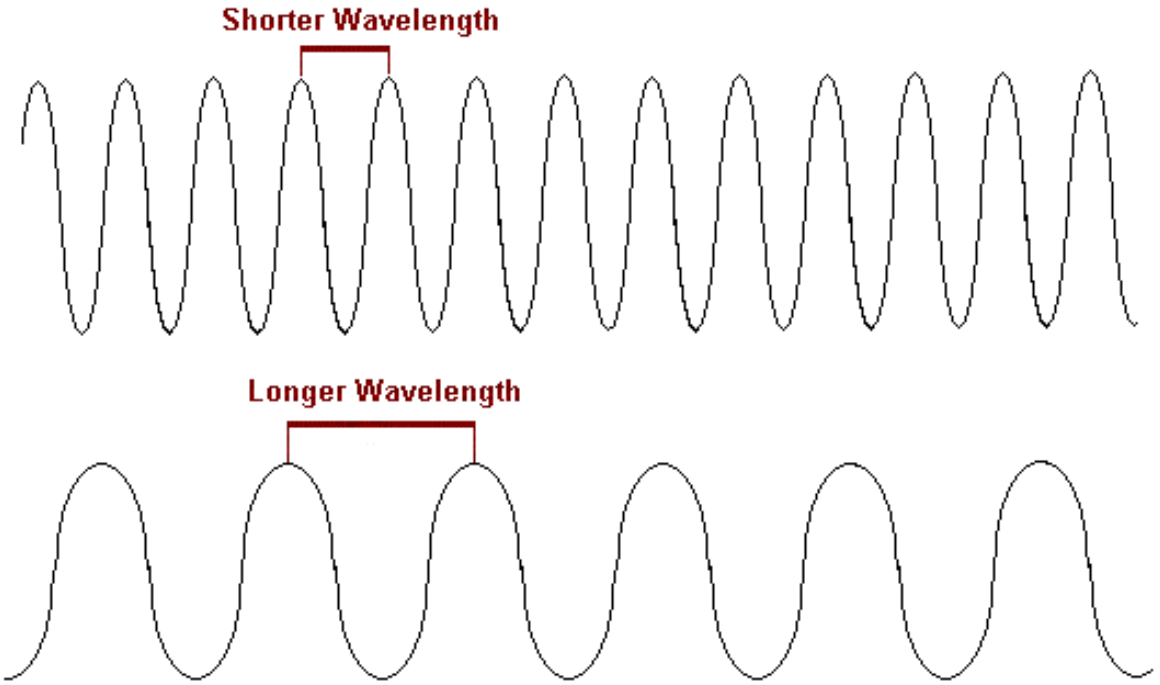


25m - 5m = 20m

Properties of Mechanical Waves

Key point

Increasing the frequency of a wave decreases its wavelength.



Wave Speed

Key Point

Frequency and wavelength are inversely proportional meaning when one goes up, the other goes down.

Wave Speed

The speed of a wave changes when it enters a new medium.

Wave Speed

Calculating Wave Speed

Speed = wavelength x frequency

- Speed (m/s)
- Wavelength (m – meters)
- Frequency = (Hz – Hertz)

Wave Speed Examples

Example #1

A wave on a rope has a wavelength of 1.8 meters and a frequency of 2.3 Hz. What is the speed of the wave?

$S = W \times F$

$S = 1.8\ m \times 2.3\ Hz$

$S = 4.14\ m/s$

Wave Speed Examples

Example #2

A motorboat is tied to a dock with its motor running. The spinning propeller makes a surface wave with the water with a frequency of 4 Hz and a wavelength of 0.1 meters. What is the speed of the wave?

$S = W \times F$

$S = 0.1\ m \times 4\ Hz$

$S = 0.40\ m/s$

Wave Speed Examples

Example #3

What is the wavelength of an earthquake wave if it has a speed of 5,000 m/s and a frequency of 10 Hz?

W = S / F

W = 5,000 m/s / 10 Hz

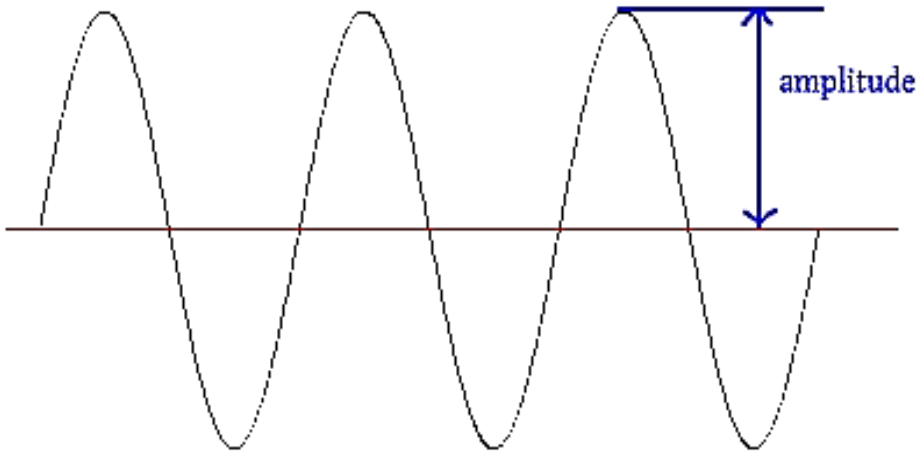
W = 500 m

Properties of Mechanical Waves

Amplitude

The maximum displacement of the medium from rest position.

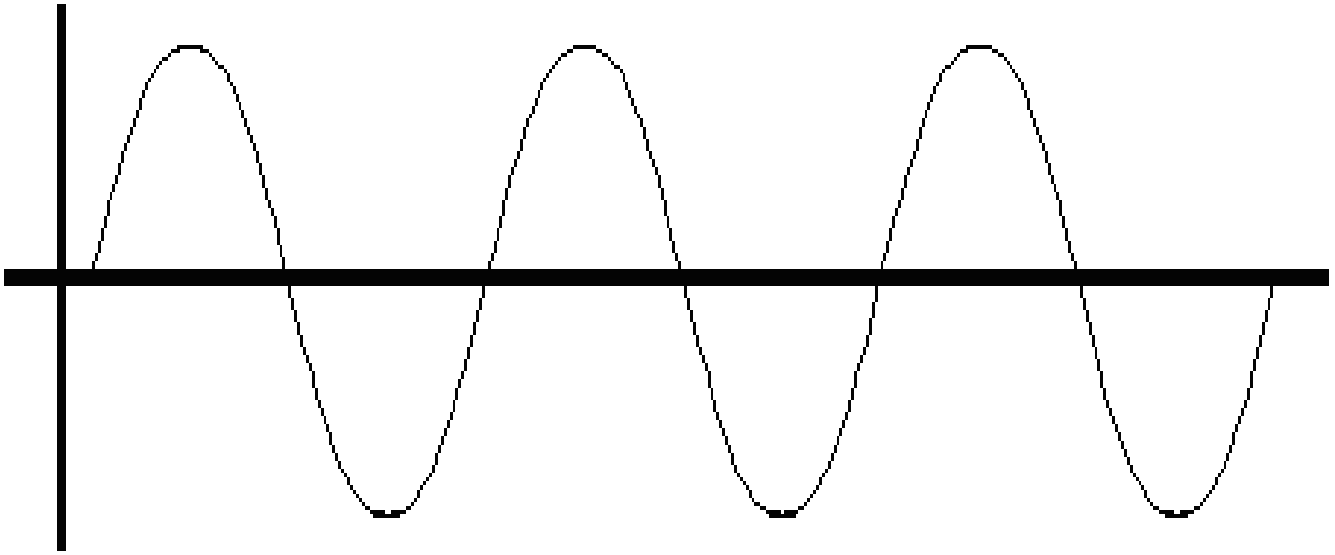
- **The more energy a wave has, the greater the amplitude**



Properties of Mechanical Waves

Label the following in the wave below:

- ✓ Rest Position
- ✓ Wavelength
- ✓ Crest
- ✓ Trough
- ✓ Amplitude



Properties of Mechanical Waves

Label the following in the wave below:

- ✓ **Rest Position**
- ✓ **Wavelength**
- ✓ **Compression**
- ✓ **Rarefaction**
- ✓ **Amplitude**

17.2 Assessment Questions

1. What are the three types of mechanical waves?

   - Transverse
   - Longitudinal
   - Surface

2. How are mechanical waves produced?

A disturbance in matter that carries energy from one place to another

17.2 Assessment Questions

3. How are transverse and longitudinal waves alike?

They both carry energy

4. How are transverse and longitudinal waves different?

Transverse carry energy at right angles
Longitudinal carry energy parallel

17.2 Assessment Questions

5. How is wavelength related to frequency?

Inversely proportional (one goes up, the other goes down)

6. How is energy of a wave related to its amplitude?

The more energy, the higher the amplitude

17.2 Assessment Questions

Example #7

A wave on a rope has a frequency of 3.3 Hz and a wavelength of 1.2 meters. What is the speed of the wave.

$S = W \times F$

$S = 1.2\ m \times 3.3\ Hz$

$S = 3.96\ m/s$