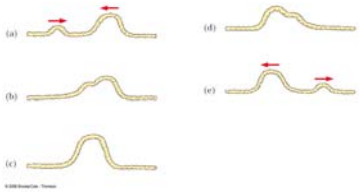
1.3 Waves

Superposition and Interference
Reflection and Transmission

Superposition Principle

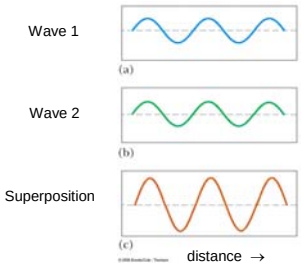
- When two waves overlap in space the displacement of the wave is the sum of the individual displacements.



Interference

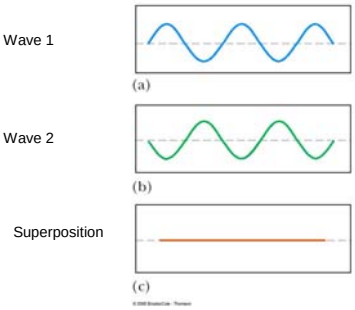
- Superposition of harmonic waves depends on the relative phase of the two waves
- Can lead to
  - Constructive Interference
  - Destructive Interference

Constructive Interference



The two waves have the same phase

Destructive Interference

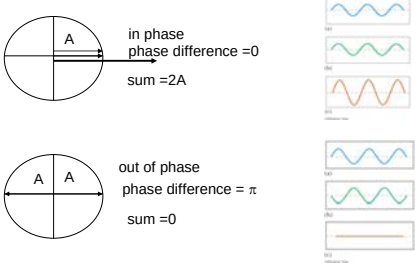


The two waves are out of phase (by 180° , or π)

Phasor Addition

To sum the displacements due to two waves with the same frequency add the two rotating vectors.

The phasor sum will be rotating at the same frequency.



Phasor addition can be used for other angles and ampltudes.

Other Interference Effects

Many other effects arise from superposition of harmonic waves – discussed later.

Standing waves. two waves traveling in opposite directions.

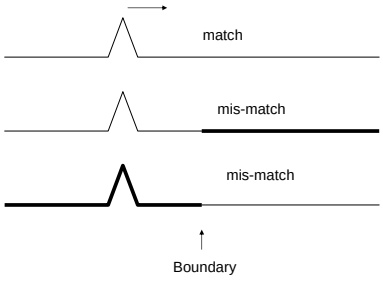
Beats. two waves with different frequencies.

Diffraction. Interference in wave patterns in space.

Reflection and Transmission.

- When a wave reaches a boundary, part of the wave is reflected and part of the wave is transmitted.
- The amount reflected and transmitted depends on how well the media is matched at the boundary.
- The sign of the reflected wave depends on the "resistance" at the boundary.

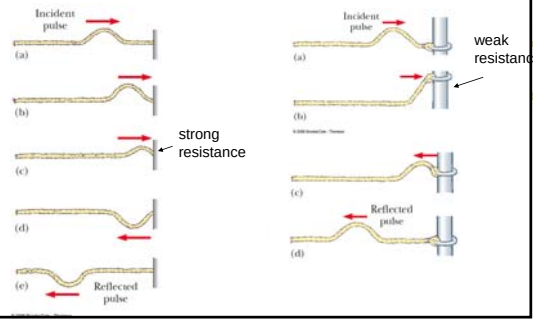
Mis-match at the boundary



Reflection

Fixed End-
Inversion

Free End-
No Inversion



Clicker question 3

A wave on a string goes from a thin string to a thick string. What is the best picture that represents the wave some time after hitting the boundary?