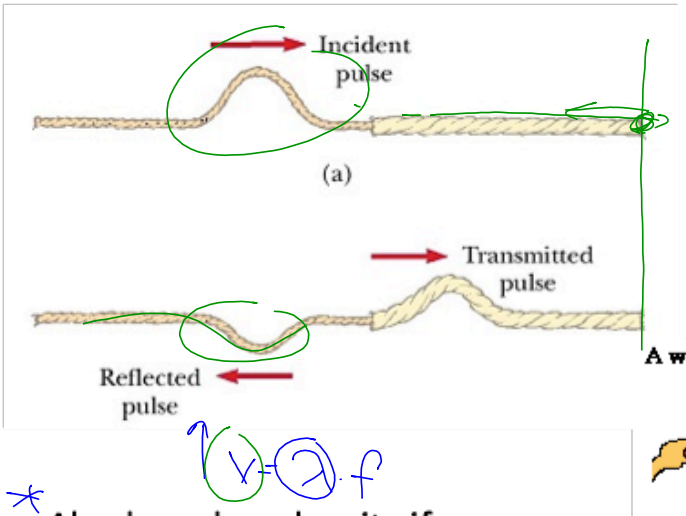
Wave Reflection & Transmission

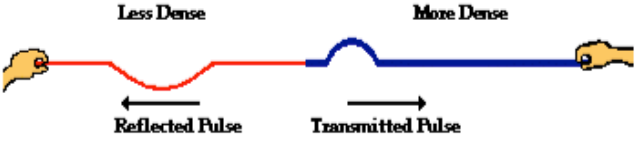
- When meeting an obstacle



- 'Bounces' off obstacle. (What do we call this with sound?)

- Also based on density if a wave travels to a new medium
  - Velocity changes and therefore the wavelength rather than frequency

A wave traveling from a less dense to a more dense medium ...



Changes in Waves

- One Formula: $v = \lambda f$

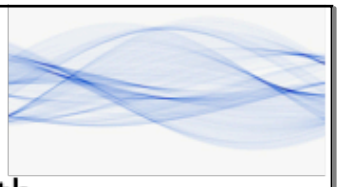
Velocity is slower in less denser materials, faster in more dense

Wavelength changes, rather than frequency

$E = hf$

Frequency is related to the energy of the wave (conservation of energy)

Example 1



If the frequency of a sound is doubled, the wavelength....

A. halves and the speed remains unchanged
B. doubles and the speed remains unchanged
C. is unchanged and the speed doubles
D. is unchanged and the speed halves
E. halves and the speed halves

$v = \downarrow\lambda \cdot f\uparrow$

* v speed based on medium

Example 2

A wave travels from steel to air both its speed and its ....

A. wavelength increase

B. wavelength decrease

C. frequency increase

D. frequency decrease

E. frequency remains unchanged

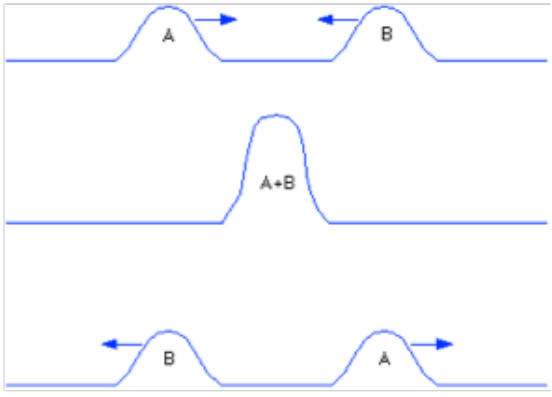
$\downarrow v = \downarrow \lambda \cdot f$

Wave Interference

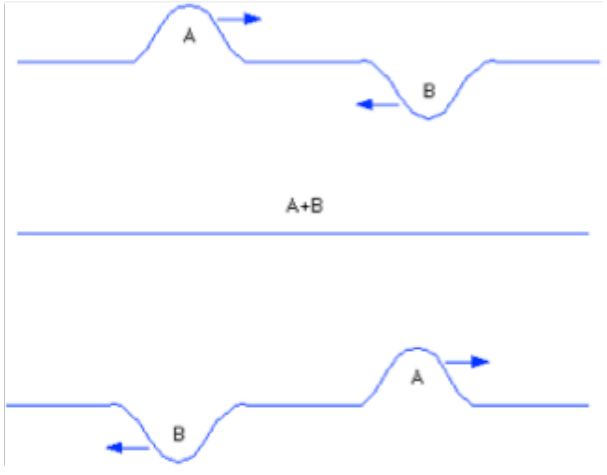
- When multiple waves interact, the waves are stacked on top of each other or 'superimposed'
    - We call this the **superposition** of waves
- Waves pass through each other all the time but only interact when they are in the same place at the same time.

Wave Interference

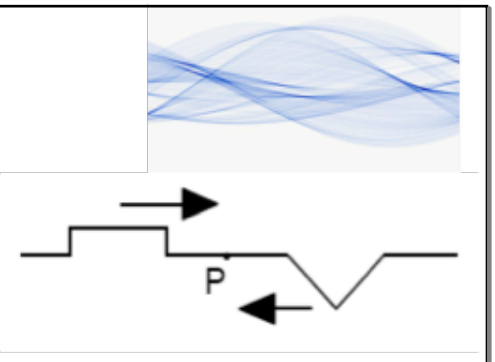
- Constructive Interference – Result is a larger amplitude



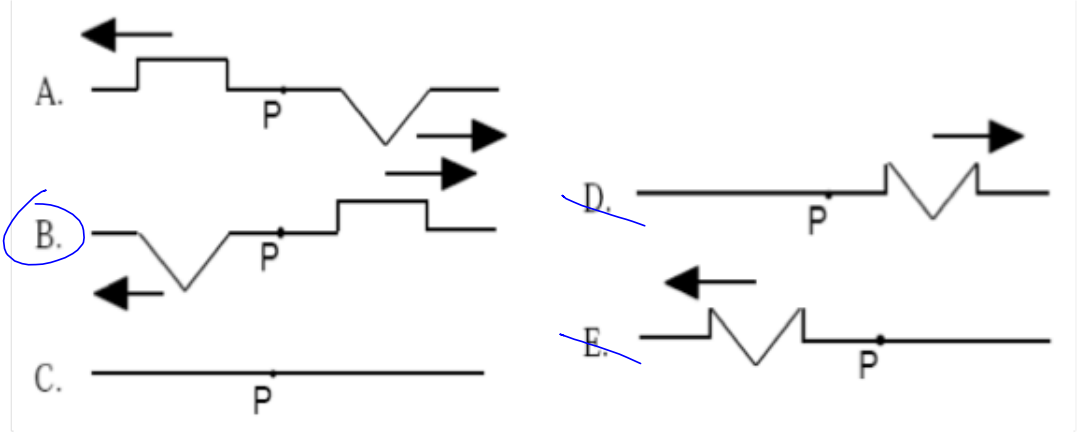
- Destructive Interference – Result is a smaller amplitude



Example 3



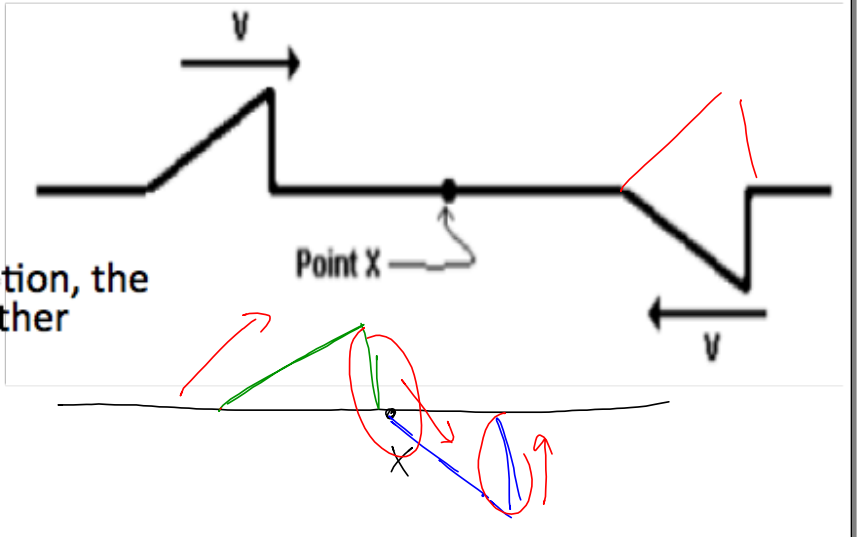
Two wave pulses approach each other as seen in the figure provided. The pulses overlap at point P. Which diagram best represents the waves as they leave point P?



Example 4

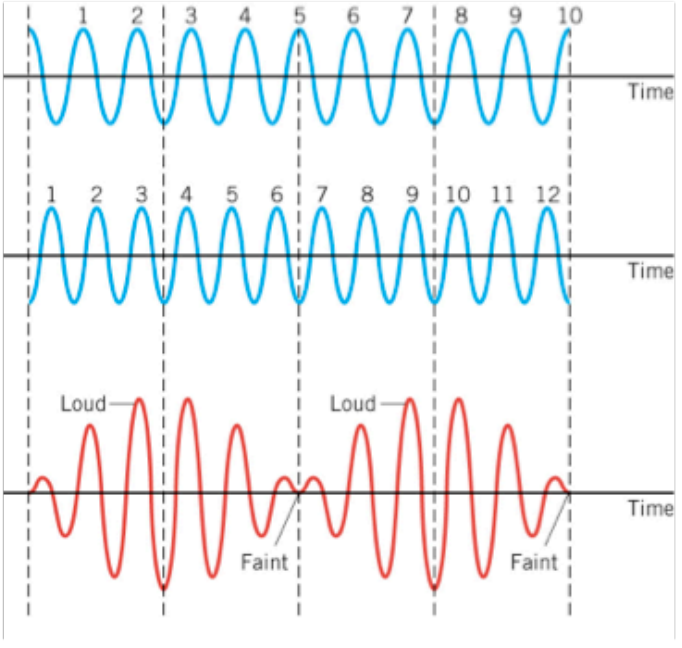
The diagram shows two transverse pulses moving along a string. One pulse is moving to the right and the second is moving to the left. Both pulses reach point x at the same instant. What would be the resulting motion of point x as the two pulses pass each other.

A. up then down
B. down then up
C. up, down, up
D. down, up, down
E. there would be no motion, the pulses cancel one another



The 'Beats'

- If two sounds are only *slightly* off in terms of frequency



- Produce a periodic rise and fall of amplitude (volume)
- Throbbing Sound = Beats

The Beats

- # 'beats' = how far apart the two frequencies are

280 283 = 3 Hz

$$Beats = |f_1 - f_2|$$

280 - 279.8

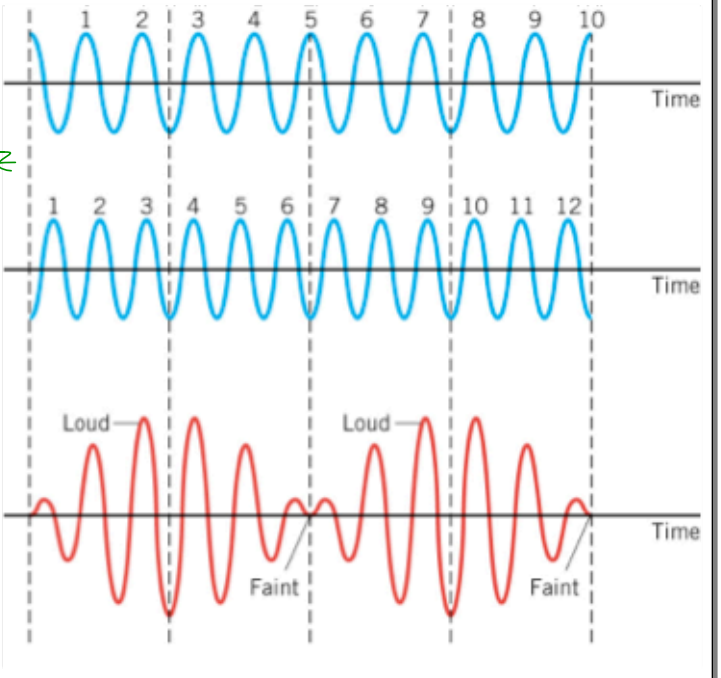
0.2 Hz

- Ex.

Tuning Fork 1: f = 440 Hz

Tuning Fork 2: f = 442 438

*Beat Frequency of 2 Hz?



Example 7

One stereo loudspeaker produces a sound with a wavelength of 0.68 meters while the other speaker produces sound with a wavelength of 0.65 m. What would be the resulting beat frequency?

A. 3 Hz
B. 23 Hz
C. 66.5 Hz
D. 500 Hz
E. 11333 Hz

two speakers

$\lambda = 0.68\ m$ $\quad f = 500$

$\lambda = 0.65\ m$ $\quad f = 523$

$v = \lambda \cdot f$

$340 = \lambda \cdot f$