Crave The Wave

By: Hans Furlough

hfurlough@nc.rr.com

Put “SO” in the subject

DESCRIPTION

- In this event students will demonstrate knowledge and process skills needed to solve problems and answer questions regarding all types and areas of waves and wave motion.
- 2 Students
- 50 minutes

EVENT PARAMETERS

- Printed materials
- Notes
- Scientific calculators

- **A resource binder is permitted.**
  - **All papers must be secured in a 3 ring binder and must be 3-hole punched and inserted in the binder so none can fall out in any orientation.**
  - **The binder and all papers must be able to fit in a 3” x 12” x 12” box without compression from students or judges.**

SCORING

- Points will be awarded for the accuracy and quality of the responses. Ties will be broken using pre-selected questions.

Task Types

- **Types of tasks students will be presented with:**
  - questions
  - hands-on tasks at stations requiring them to draw and label diagrams to demonstrate knowledge of introductory concepts,
  - record observations,
  - make predictions,
  - interpret data,
  - generate inferences,
  - solve problems,
  - formulate and evaluate hypotheses.

Regional Topics

- General Wave Characteristics
  - Wavelength, amplitude, frequency, period
- Wave Types
  - Transverse, longitudinal, surface, torsional waves
- Wave Phenomenon
  - Sound - reflection, refraction, effect of media, Doppler Effect
- Electromagnetic Waves
  - Electromagnetic spectrum, relationship b/n frequency and wavelength, energy carried (AM/FM only) – standard wavelength bands, their uses and dangers
- Spectroscopy
  - Primary colors of light

State Topics

- Wave Phenomenon
  - Light – constructive and destructive interference
    - Standing waves
    - Diffraction
    - Doppler effect
  - Spectroscopy
    - Absorption spectra
    - Primary colors of pigments
    - Emissions spectra
  - Earthquake/Seismic Waves
    - P-waves
    - S-waves
    - Rayleigh Waves
    - Love waves
    - Surface waves

National Topics

- Boundary Effects
  - Breaking ocean waves, Tsunamis
- Local and global socio-economic effects
  - Passage will describe the social or economic effect of the discovery, harnessing, controlling and/or licensing of waves and questions regarding the direct effects of the wave related event will be asked.

Sample Tasks

- At a particular level of competition the event may contain topics or tasks from previous levels.
- Regional Topics
  - Label the parts of a wave
  - determine frequency
  - period or wavelength of a wave
  - determine the angle of refraction of a prism
  - measure and label the angles of incidence and refraction and the normal of a mirror
  - listen to a recording and determine whether a truck is moving towards or away from you
  - given pictures of items or places identify the type of light used to take these pictures
  - given papers with colored circles and a flashlight hidden inside a black box, determine the color of the filter over the flashlight

Sample State Tasks

- using a recording of two trucks determine which one is moving faster
- given graphs of two waves draw the resulting wave (interference) given p-wave and s-wave diagrams determine the distance to the epicenter

Sample National Tasks

- National Topics
  - measure the width of a hair using a laser
  - label and describe the action of a breaking wave and the economic impact when these waves increase during storm surges

What type of wave is shown?

What wave phenomenon is demonstrated?
Does this phenomenon occur only in sound waves?

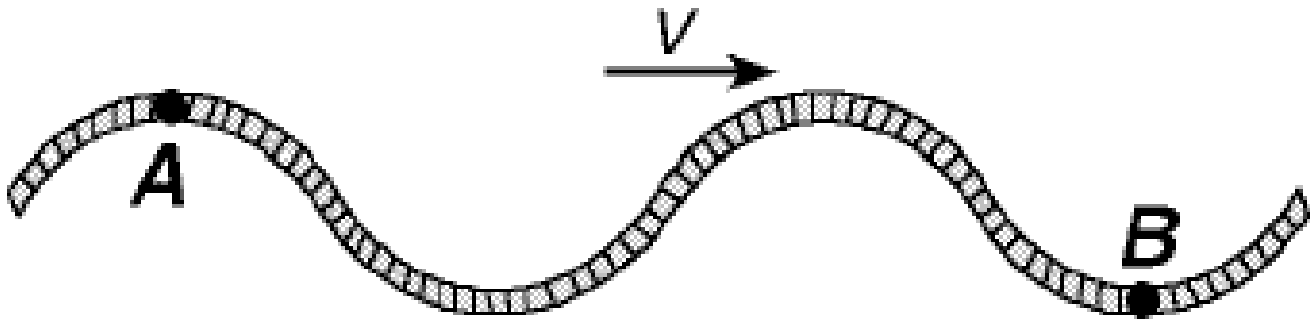
Is the truck moving

a) Toward the recorder
b) Away from the recorder
c) At the same speed and direction as the recorder

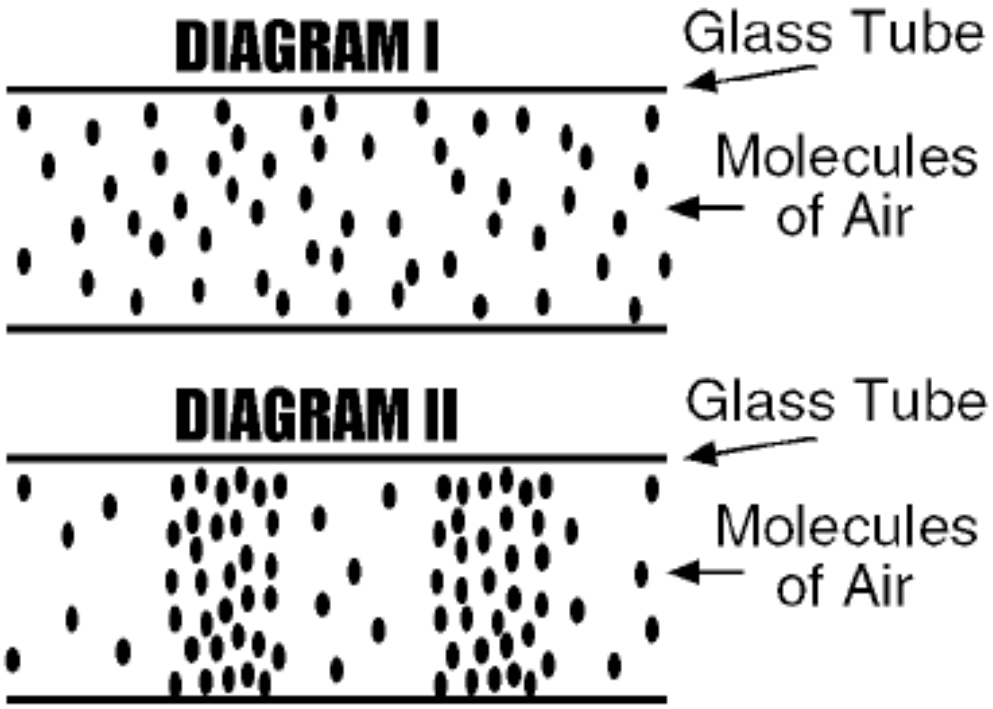
Is the truck moving

a) Toward the recorder
b) Away from the recorder
c) At the same speed and direction as the recorder

A periodic wave travels through a rope, as shown in the diagram below.

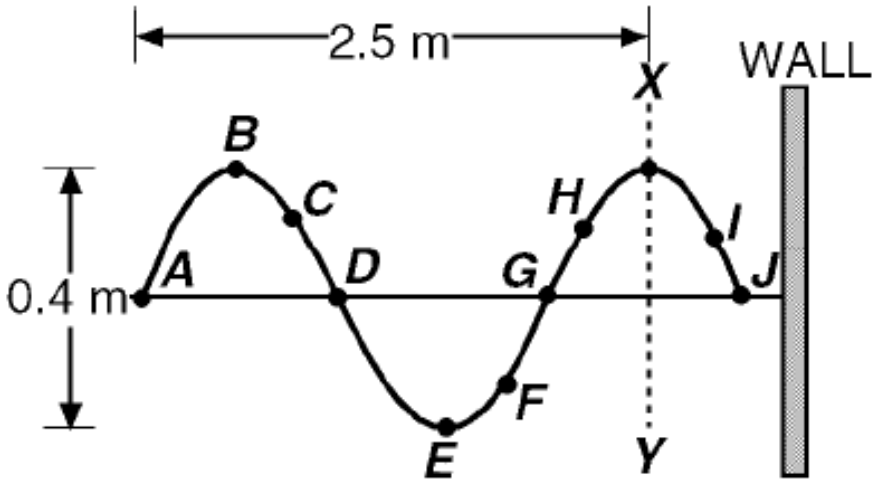


As the wave travels, what is transferred between points *A* and *B*?



Which type of wave produced the disturbance shown in diagram *II*?

A) transverse
B) elliptical
C) longitudinal
D) torsional



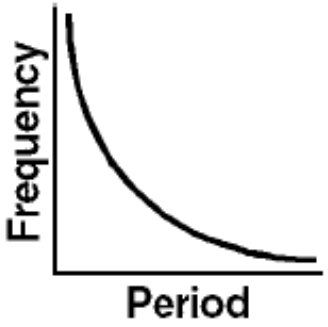
- What is the amplitude?
- What point is the crest?
- What point is the trough?
- What is the wavelength?
- What type of wave?
- If one wave passes line XY every 0.4s, what is the frequency?

1. Lots of energy
2. Pitch
3. High pitch
4. Loudness
5. High amplitude
6. Decreasing frequency
7. Increasing frequency

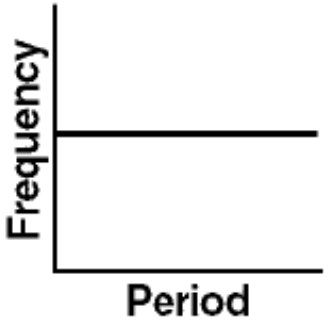
A. Amplitude
B. Loud sound
C. Frequency
D. High amplide
E. High frequency
F. Decreasing wavelength
G. Increasing wavelength

Which graph *best* represents the relationship between the frequency and period of a wave?

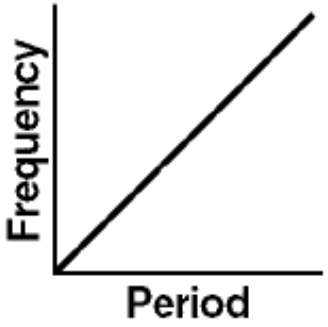
A)



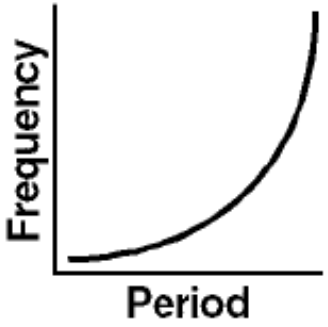
B)

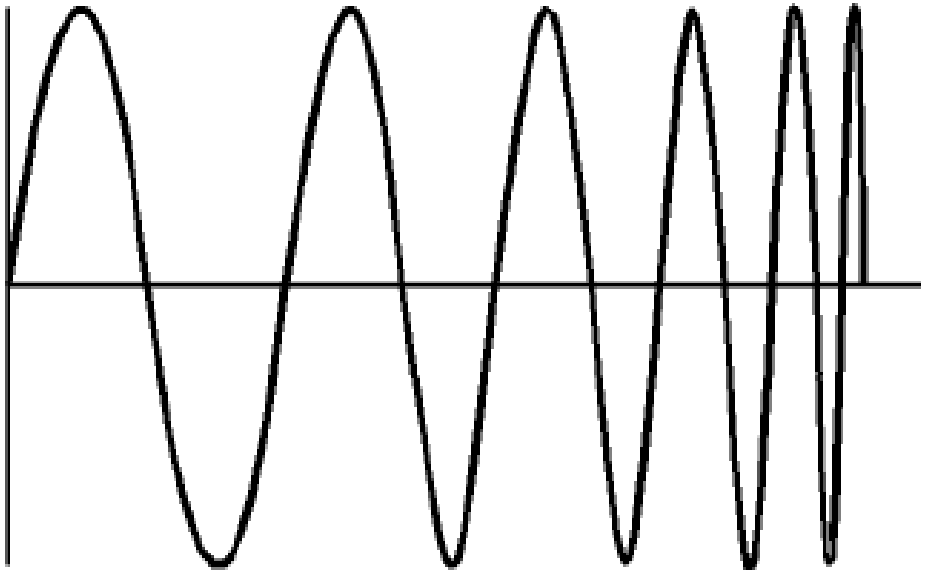


C)

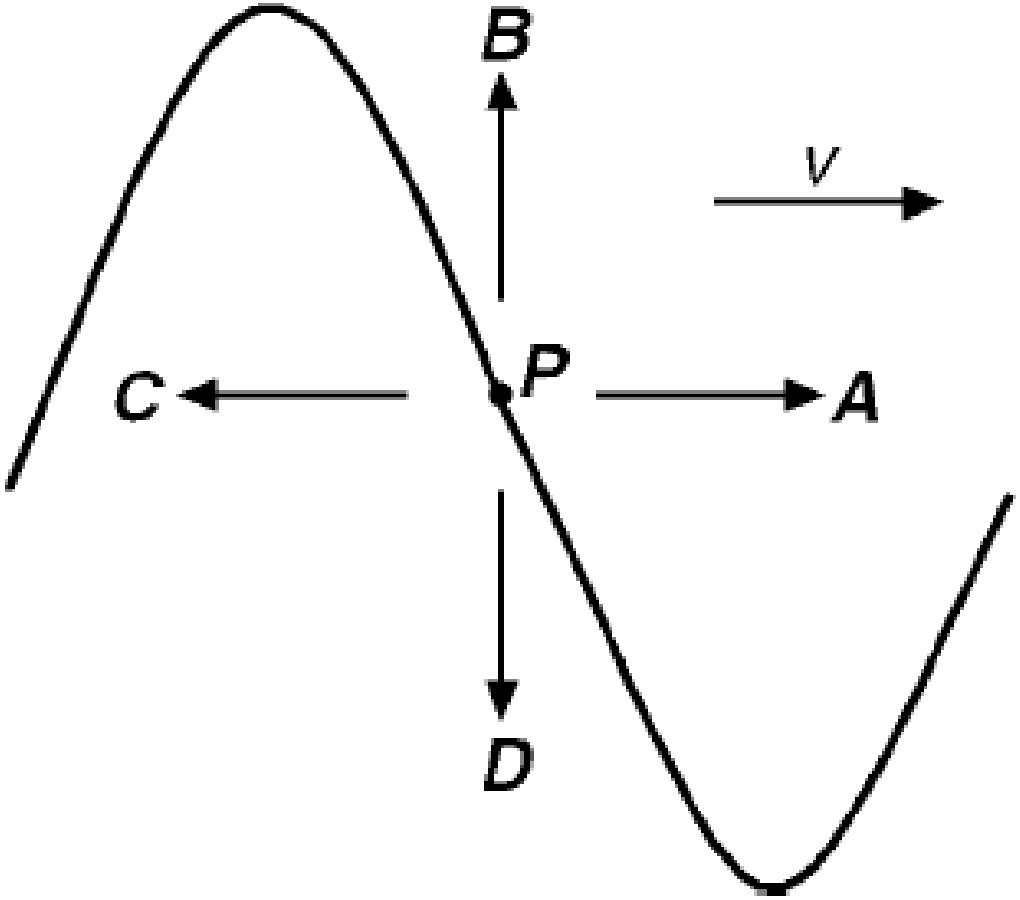


D)





- What factor is staying the same?
- What factors are changing?



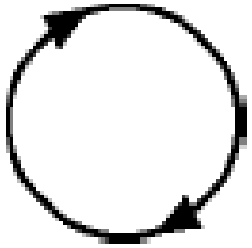
At the instant shown, a cork at point *P* on the water's surface is moving toward

A) *A* B) *B* C) *C* D) *D*

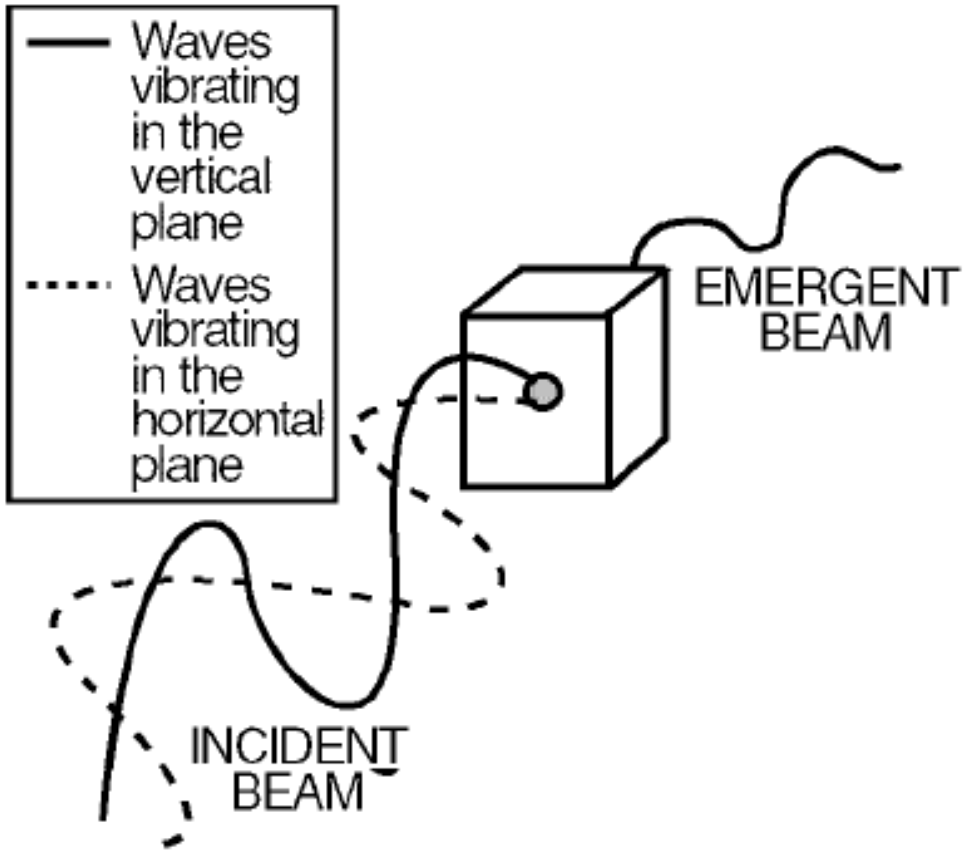
A transverse wave moves to the right (⟶) through a medium. Which diagram *best* represents the motion of the molecules of the medium due to the wave motion?

A) 

B) 

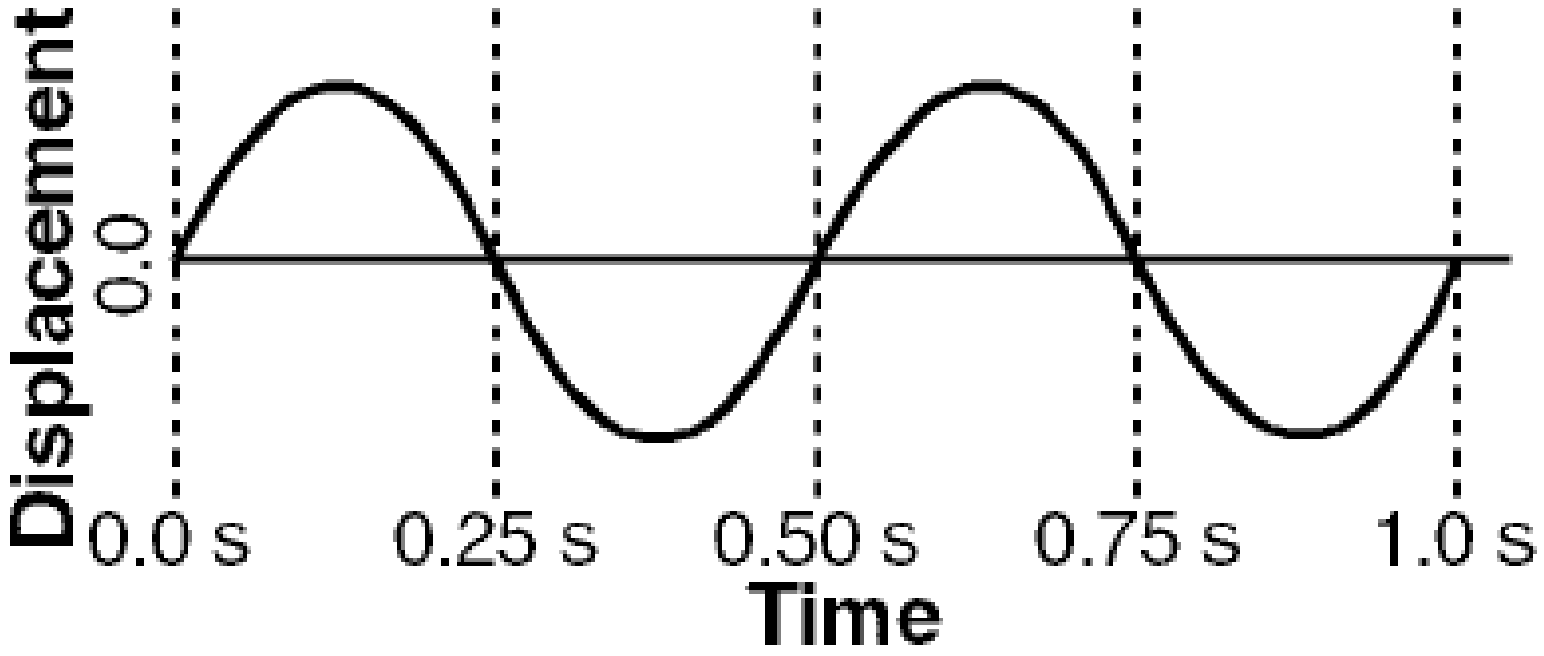
C) 

D) 



The box most likely contains a

A) polarizer
B) prism
C) converging lens
D) double slit



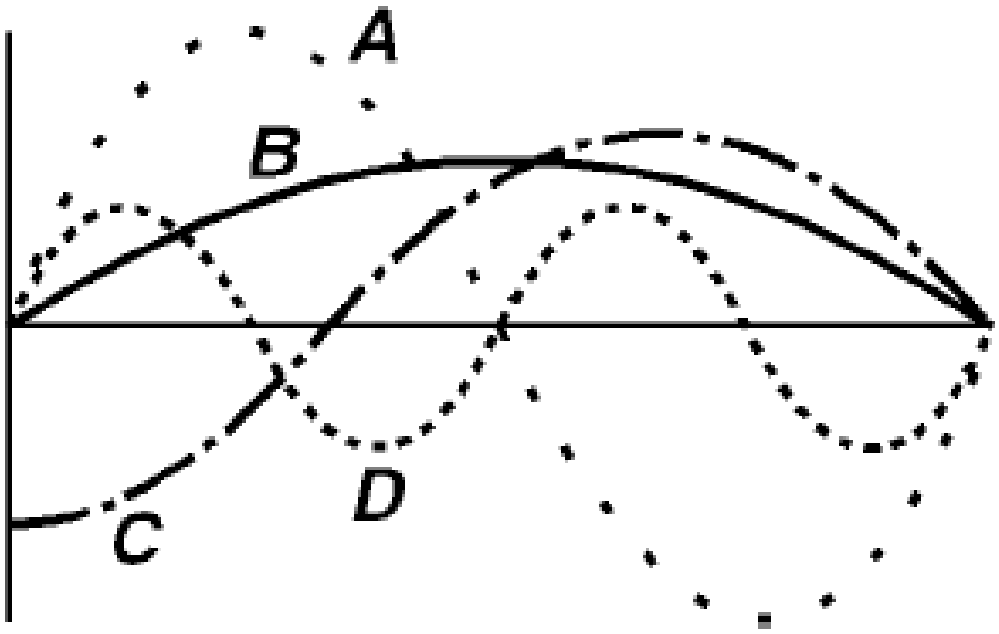
What is the frequency of the wave?

A) 0.50 Hz

B) 0.25 Hz

C) 4.0 Hz

D) 2.0 Hz



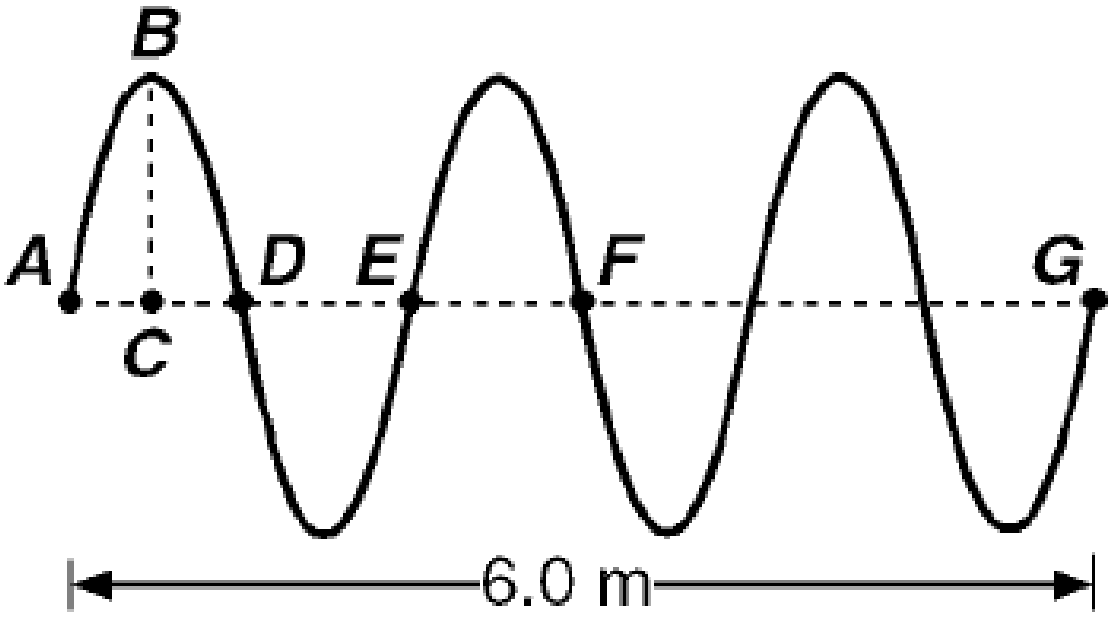
Which wave has the highest amplitude?

Which wave has the longest wavelength?

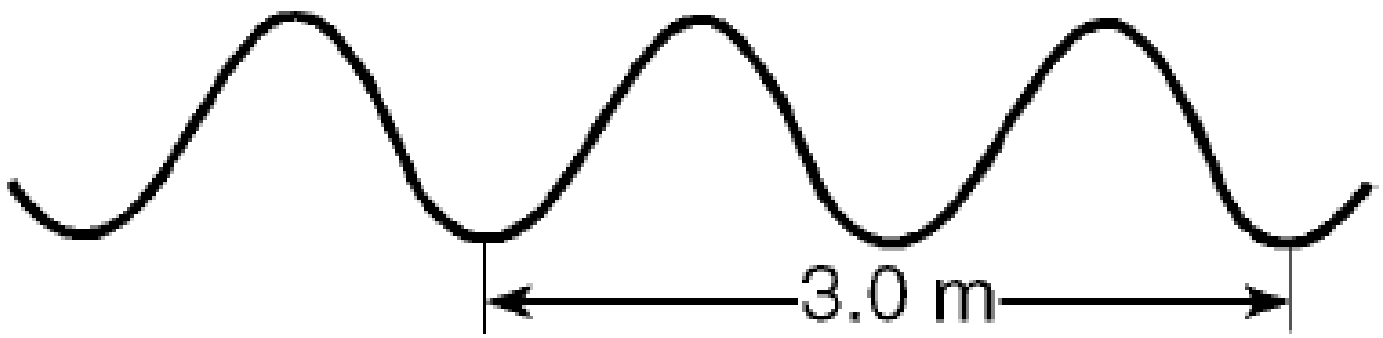
Which wave has the lowest frequency?

What is the wavelength?

The diagram below represents a vibrating string with a periodic wave originating at A and moving to G, a distance of 6.0 meters.



The periodic wave in the diagram below has a frequency of 40. hertz.



What is the speed of the wave?

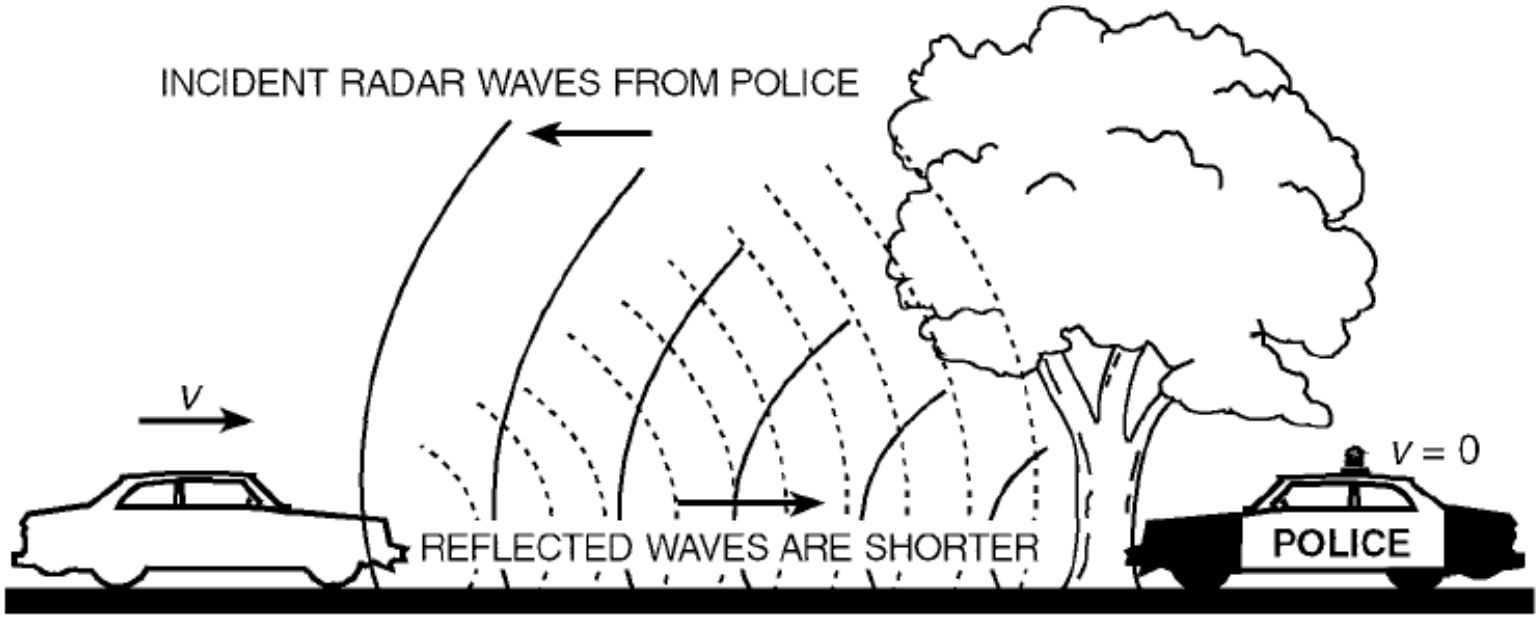
(not drawn to scale)

If the car were to accelerate toward point *A*, the frequency of the sound heard by an observer at point *A* would

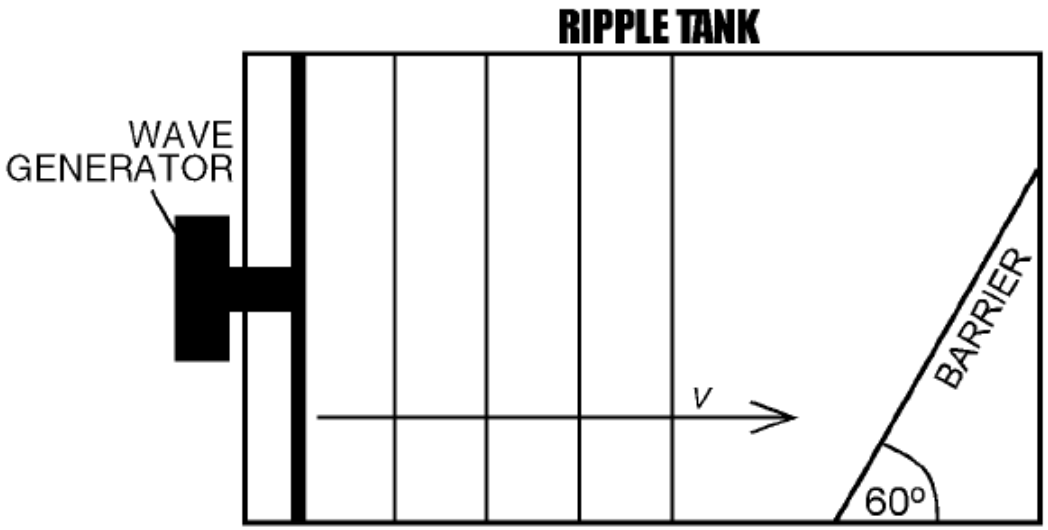
A) decrease

B) increase

C) remain the same


INCIDENT RADAR WAVES FROM POLICE
v
v = 0
REFLECTED WAVES ARE SHORTER
POLICE

A barrier is placed in the ripple tank as shown in the diagram below.



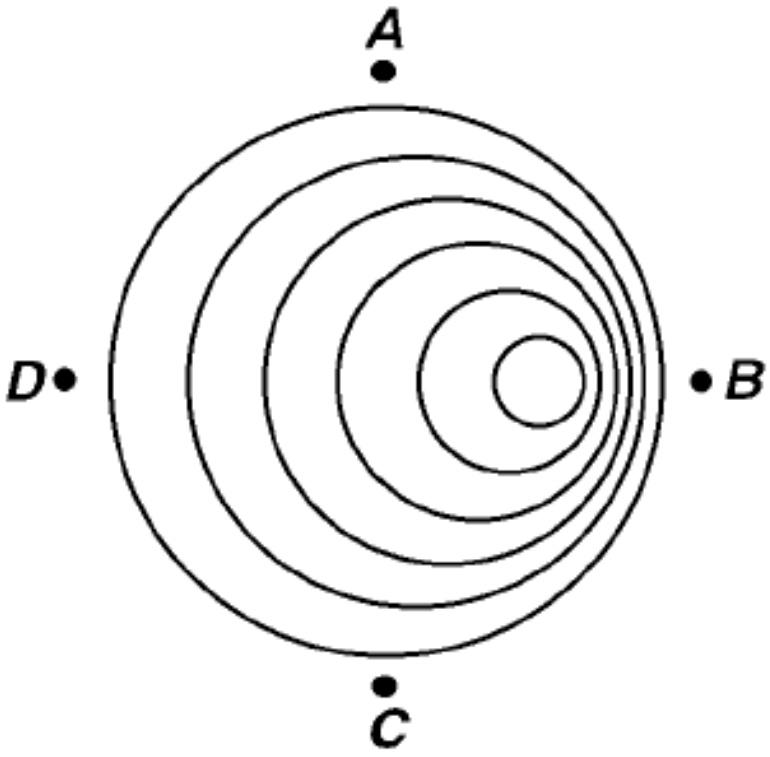
On the diagram, use a protractor and straightedge to construct an arrow to represent the direction of the velocity of the reflected waves.

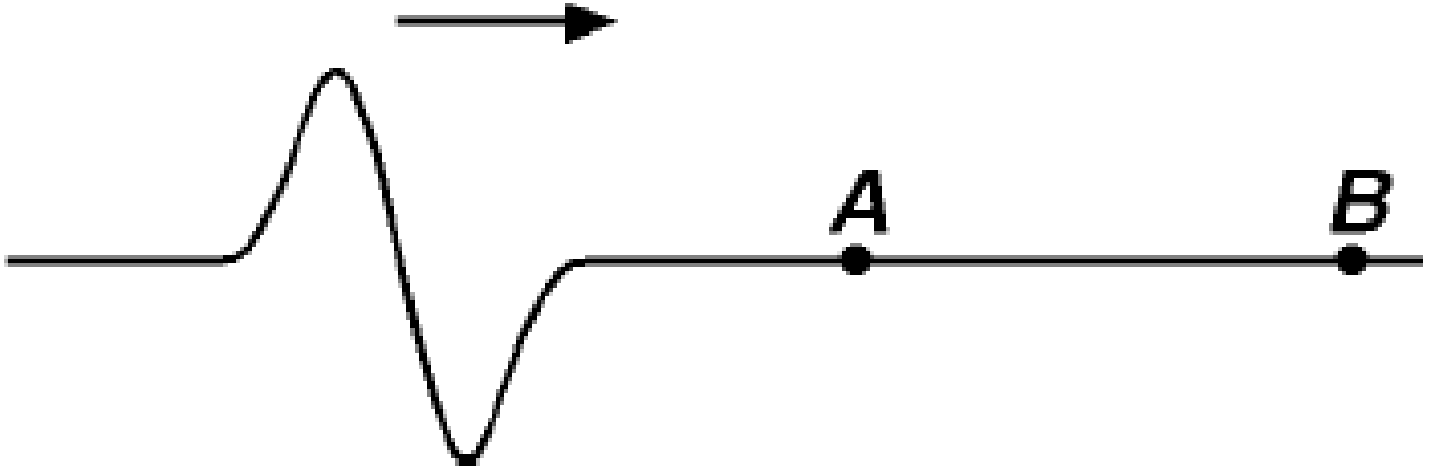
Compared to the frequency of the waves observed at point *D*, the frequency of the waves observed at point *B* is

A) the same
B) higher
C) lower

The velocity of the source is increased. The wavelength of the waves observed at point *D* will

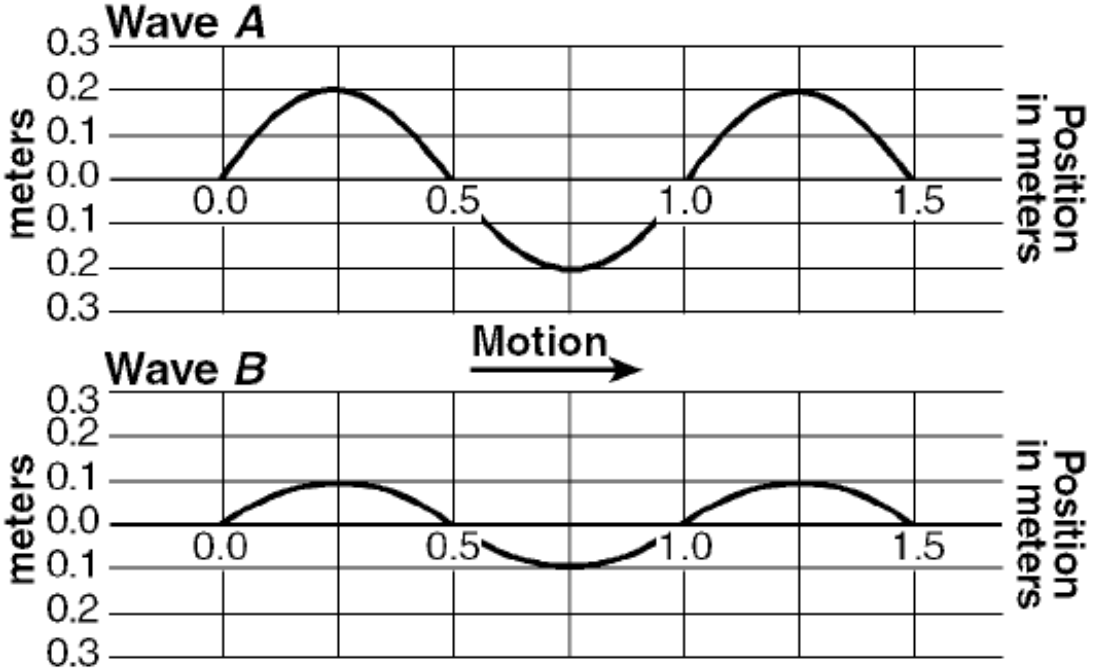
A) increase
B) decrease
C) remain the same



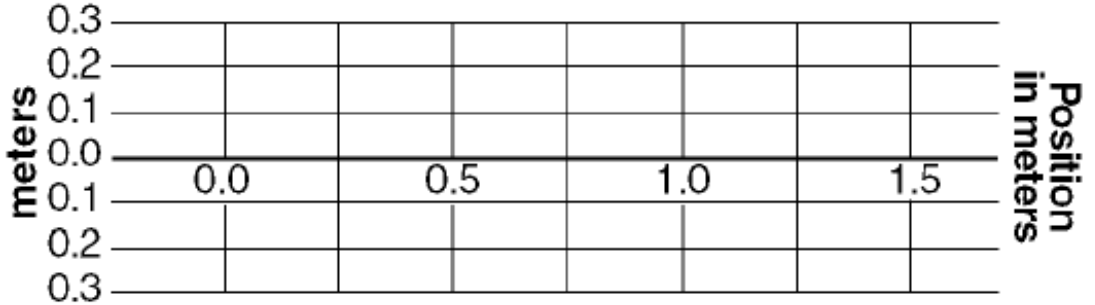


The displacement of point *A* after the wave has passed point *B* will be

Two waves, *A* and *B*, travel in the same direction in the same medium at the same time.



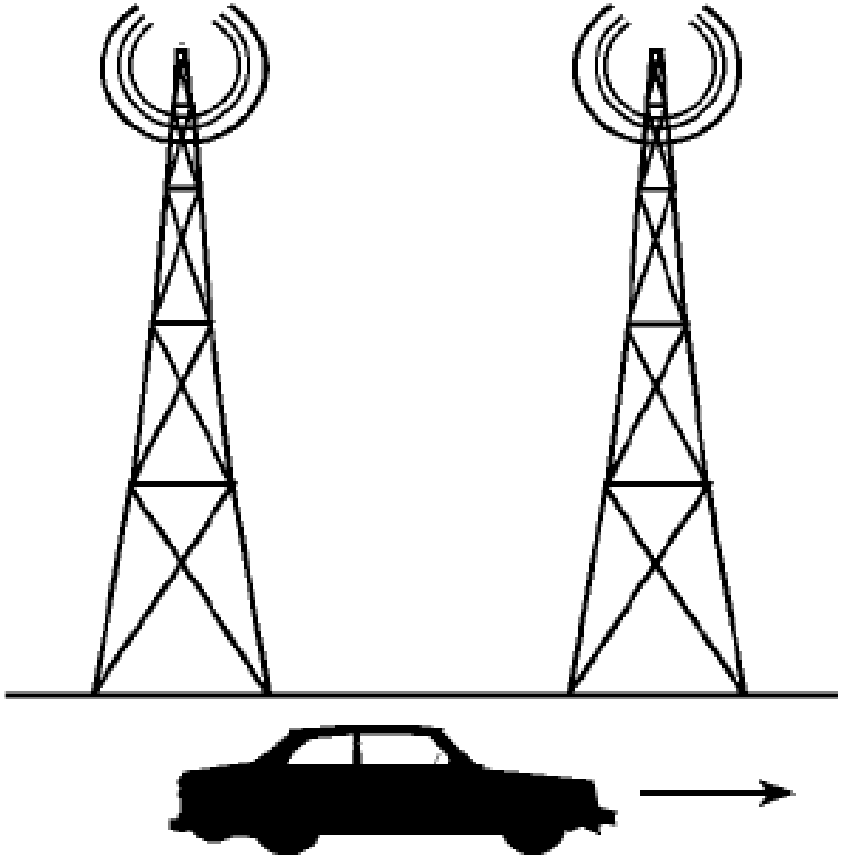
(a) On the graph below, draw the resultant wave produced by the superposition of waves *A* and *B*.



(b) What is the amplitude of the resultant wave?

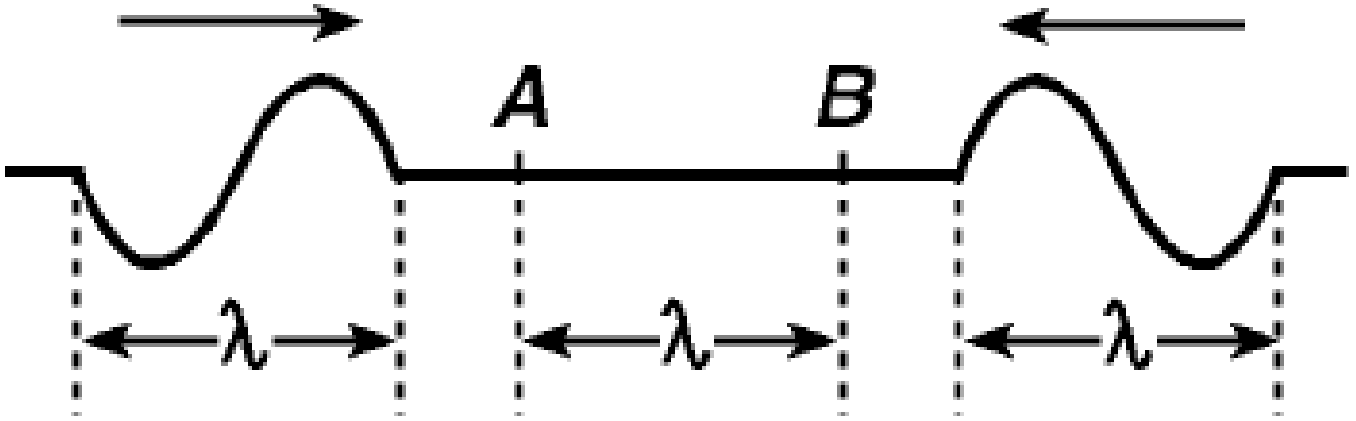
(c) What is the wavelength of the resultant wave?

A car radio is tuned to the frequency being emitted from two transmitting towers. As the car moves at constant speed past the towers, as shown in the diagram below, the sound from the radio repeatedly fades in and out.



This phenomenon can *best* be explained by

The diagram below shows two pulses, each of length λ, traveling toward each other at equal speed in a rope.



Which diagram *best* represents the shape of the rope when *both* pulses are in region *AB*?

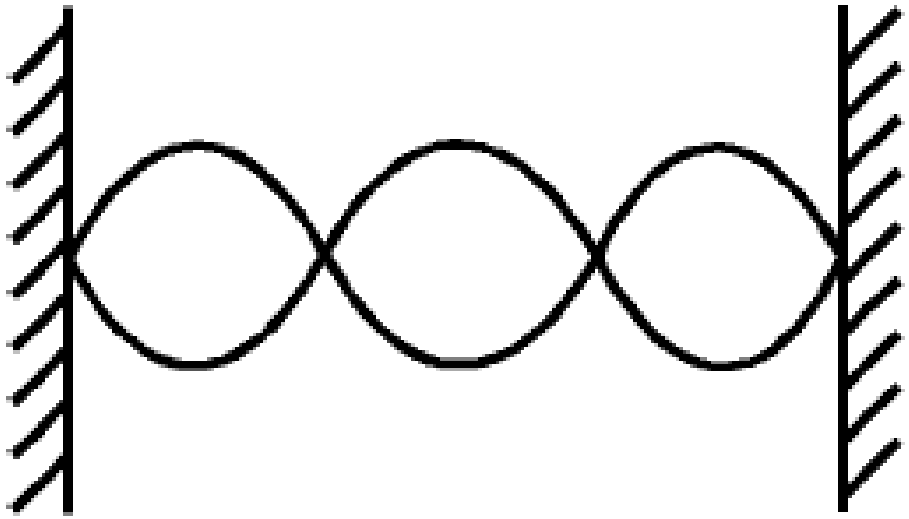
A) 

B) 

C) 

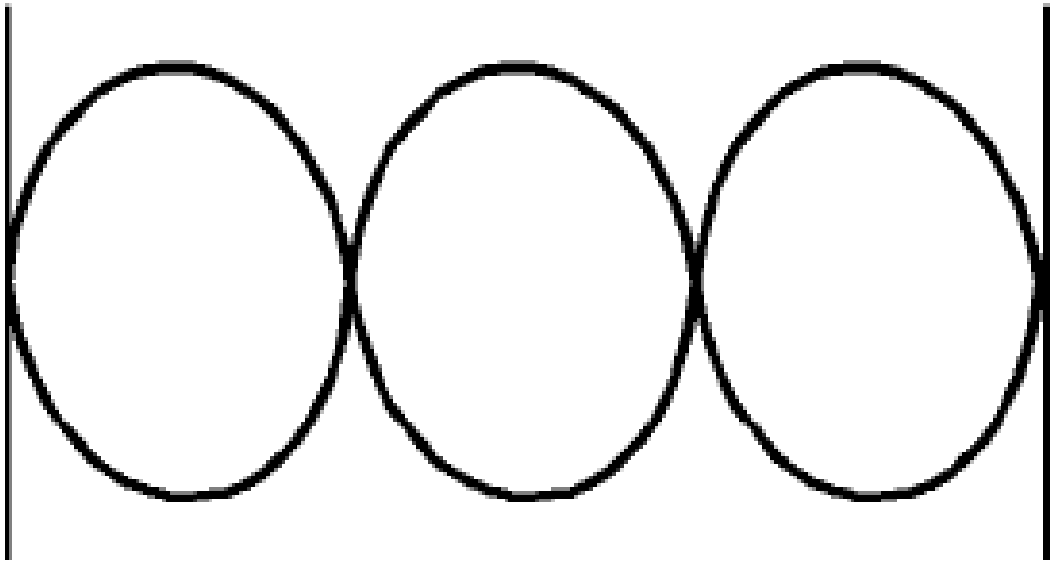
D) 

How many nodes are represented in the standing wave diagram below?



A) 2 B) 3 C) 4 D) 6

Two waves of the same wavelength (λ) interfere to form a standing wave pattern as shown in the diagram. What is the straight-line distance between consecutive nodes?

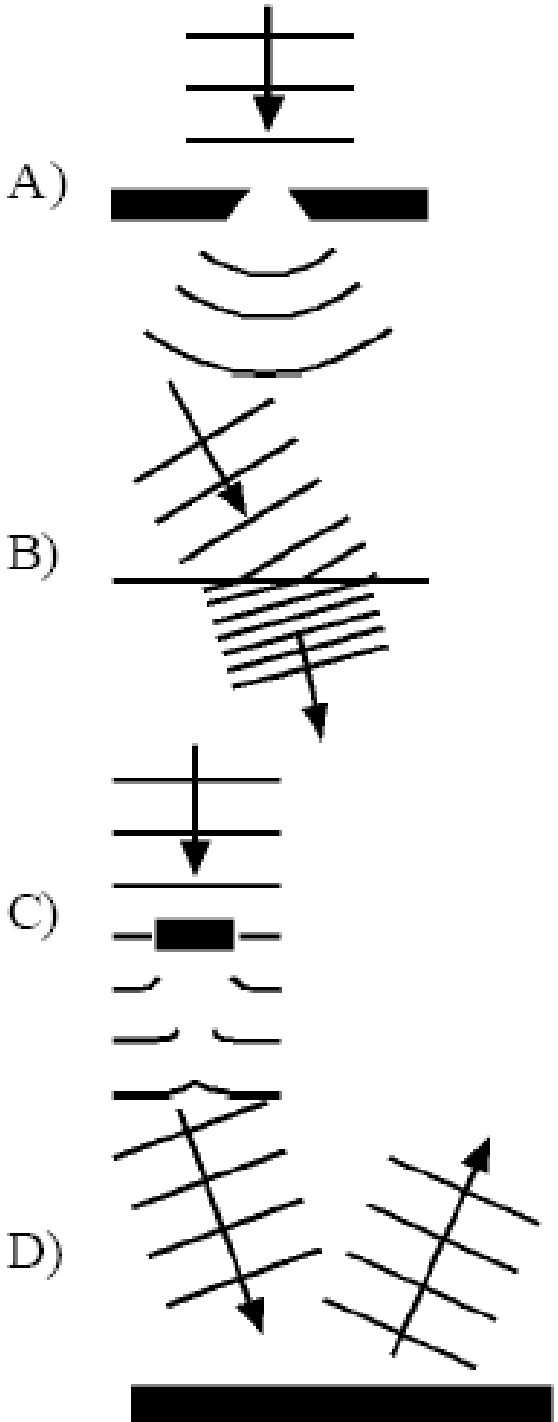


A) $\frac{1}{2}\lambda$

B) 2λ

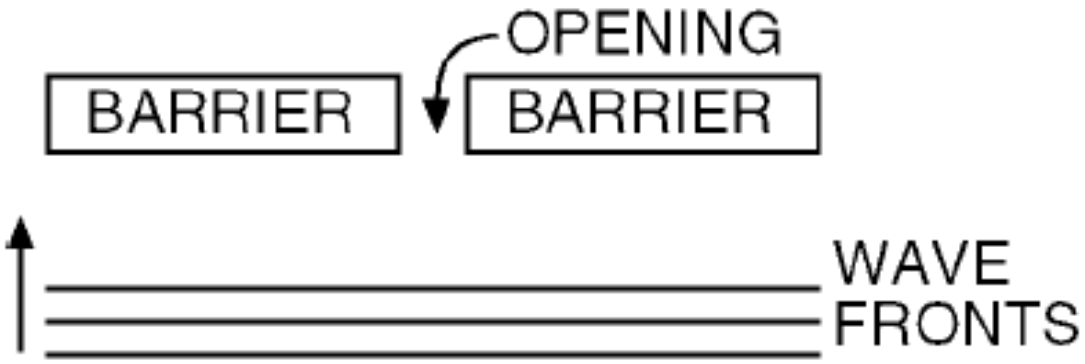
C) 1λ

D) $\frac{1}{4}\lambda$

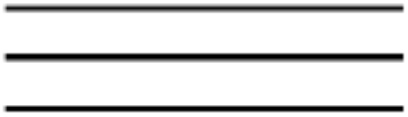


Label A-D

The diagram below represents straight wave fronts approaching an opening in a barrier.



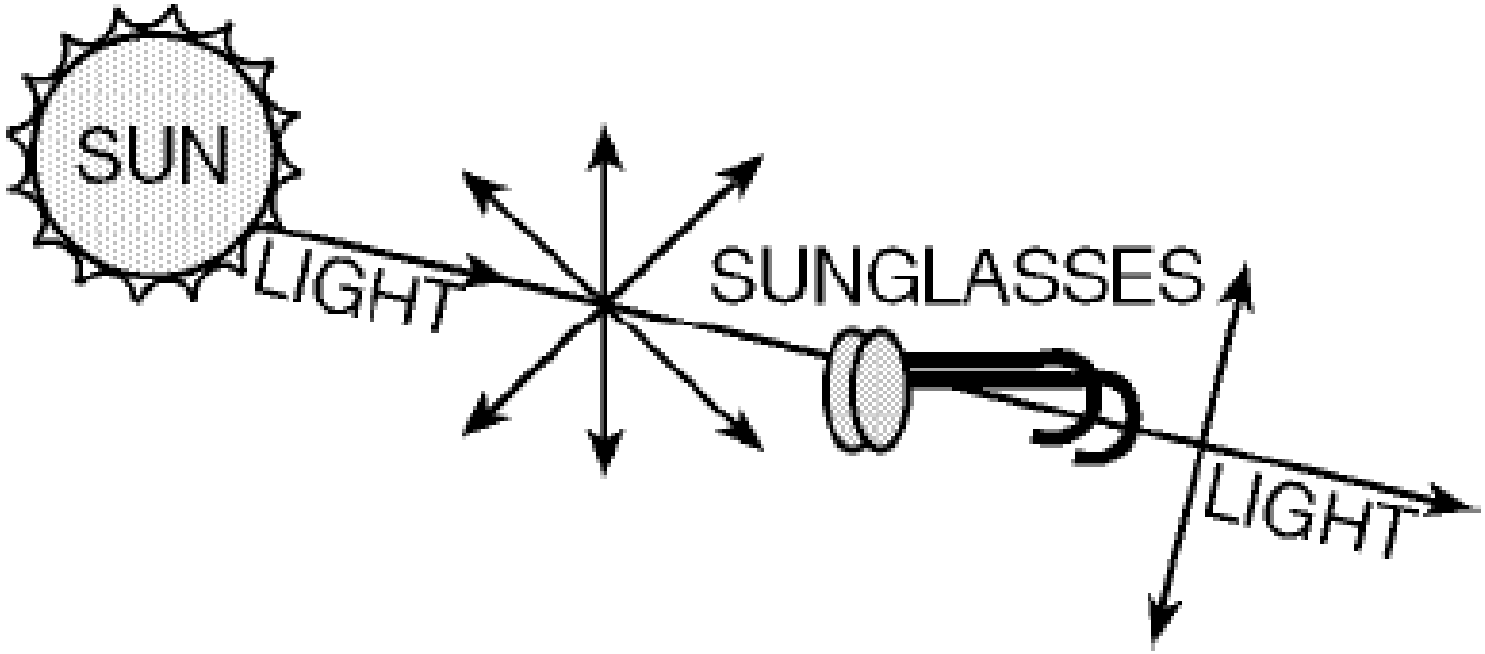
Which diagram *best* represents the shape of the waves after passing through the opening?

A) 

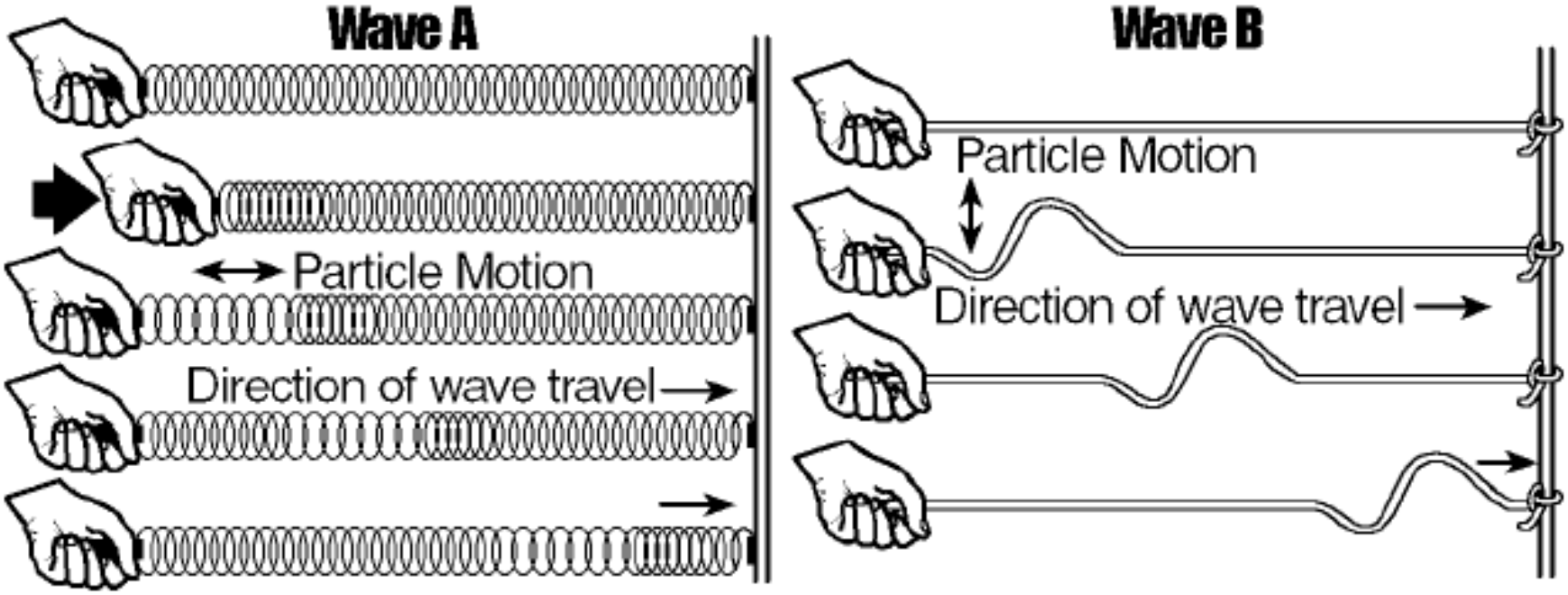
C) 

B) 

D) 



Which phenomenon of light is represented in the diagram?


Wave A
Particle Motion
Direction of wave travel
Wave B
Particle Motion
Direction of wave travel

Web Resources

- http://id.mind.net/~zona/mstm/physics/physics.html
- http://www.colorado.edu/physics/2000/index.pl?Type=TOC
- http://www.phy.ntnu.edu.tw/ntnujava/index.php?topic=19
- http://www.hazelwood.k12.mo.us/~grichert/sciweb/waves.htm
- http://www.grc.nasa.gov/WWW/K-12/airplane/sndwave.html
- http://alomax.free.fr/alss/examples/hodo/hodo_example.html

- Doppler Effect http://www.lon-capa.org/~mmp/applist/doppler/d.htm
- Doppler Effect http://library.thinkquest.org/19537/java/Doppler.html
- Spectroscopy http://mc2.cchem.berkeley.edu/Java/absorption/Java%20Classes/absorption.html
- Spectroscopy http://mc2.cchem.berkeley.edu/Java/emission/Java%20Classes/emission.html
- Spectroscopy http://www.hal-pc.org/~clement/Simulations/Mixing%20Colors/rgbColor.html

- Prisms and Refraction http://web.phys.ksu.edu/vqm/laserweb/Java/Prism/Prisme.htm
- Lots of stuff http://www.educypedia.be/education/physicsjavacolor.htm
- Standing Waves http://www.physics.smu.edu/~olness/www/03fall1320/applet/pipe-waves.html
- Standing Waves http://www.walter-fendt.de/ph14e/stwaverefl.htm