Transverse Wave Interference

Dan Russell's Acoustics and Vibration Animations
https://www.acs.psu.edu/drussell/demos.html

Superposition

Reflection

A function $f(x,t)$ satisfies this PDE:

$$\frac{\partial^2 f}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 f}{\partial t^2}$$

Invent two different functions f(x,t) that solve this equation. Try to make one of them "boring" and the other "interesting" in some way.

A function f satisfies the wave equation:

$$\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$$

Which of the following functions work?

A) $\sin[k(x - vt)]$

B) $\exp[-k(x + vt)]$

C) $a(x + vt)^3$

D) All of these.

E) None of these

A function f satisfies the wave equation:

$$\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$$

Which of the following functions work?

A) $\sin[k(x - vt)]$

B) $\exp[-k(x + vt)]$

C) $a(x + vt)^3$

D) All of these.

E) None of these.

Two different functions f_1 (x,t) and f_2 (x,t) are solutions of the wave equation.

$$\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$$

Is $(A f_1 + B f_2)$ also a solution of the wave equation?

A) Yes, always

B) No, never

C) Yes, sometimes, depending of f_1 and f_2

Two different functions f_1 (x,t) and f_2 (x,t) are solutions of the wave equation.

$$\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$$

Is $(A f_1 + B f_2)$ also a solution of the wave equation?

A) Yes, always

B) No, never

C) Yes, sometimes, depending of f_1 and f_2

The 1-D wave equation is $\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$

One particular "traveling wave" solution to this is

$$f_1(z,t) = A_1\cos(k_1 z - \omega_1 t + \delta_1)$$

There are many *other* solutions, including $f_2(z,t)$ with the SAME functional form, but with higher angular frequency, $\omega_2 > \omega_1$.

What can you say about the *speed* of that new solution?

A) greater than v

B) less than v

C) equal to v

D) indeterminate!

The 1-D wave equation is $\frac{\partial^2 f}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2}$

One particular "traveling wave" solution to this is

$$f_1(z,t) = A_1\cos(k_1 z - \omega_1 t + \delta_1)$$

There are many *other* solutions, including $f_2(z,t)$ with the SAME functional form, but with higher angular frequency, $\omega_2 > \omega_1$.

What can you say about the *speed* of that new solution?

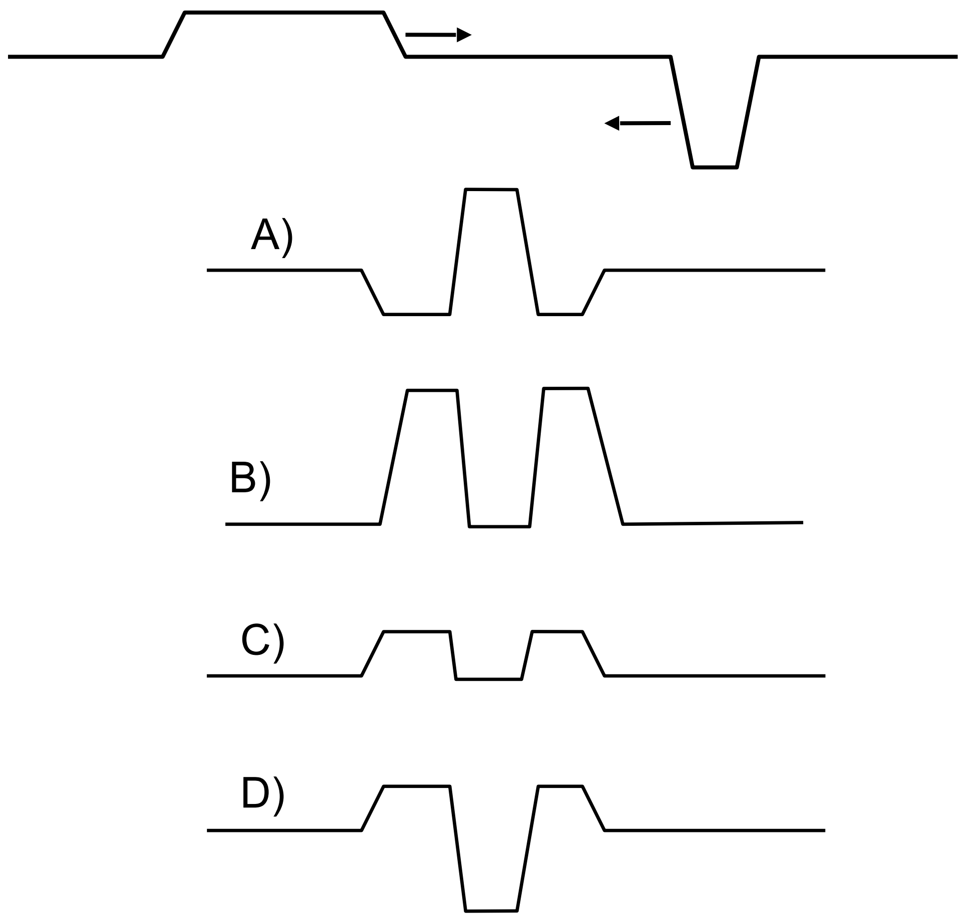
A) greater than v

B) less than v

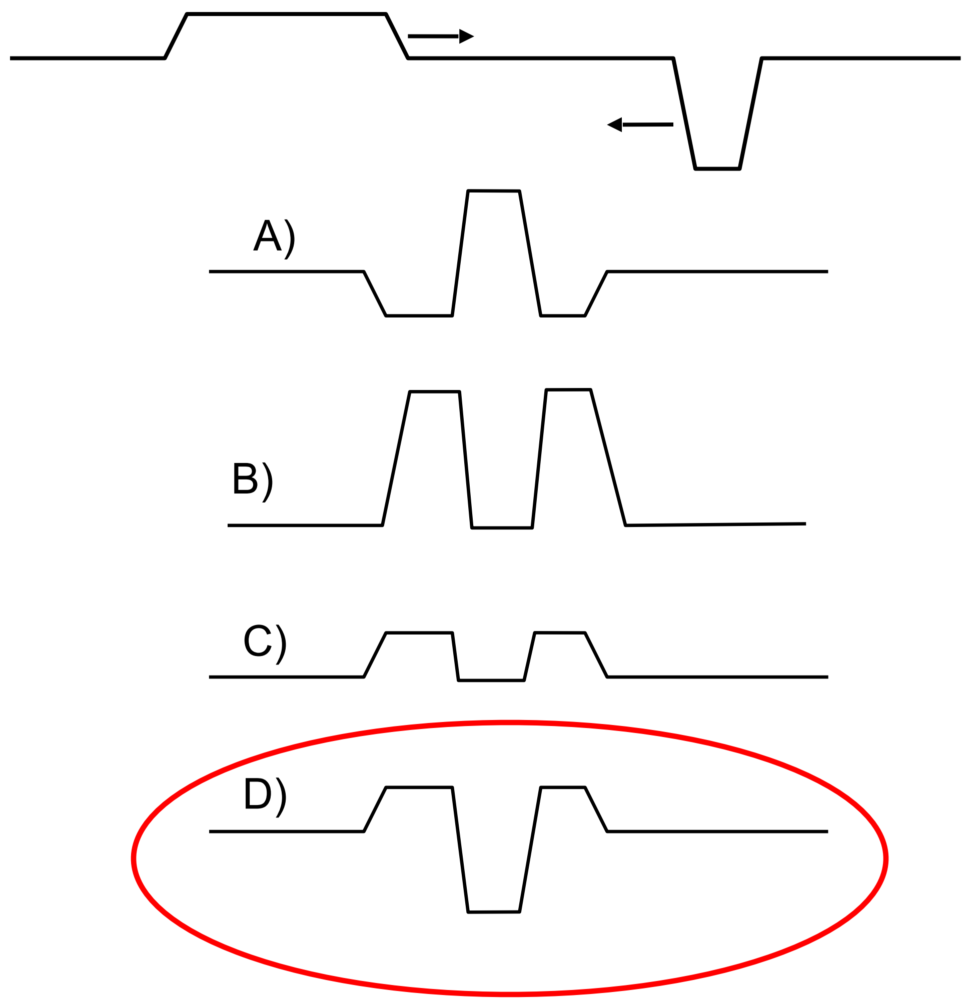
C) equal to v

D) indeterminate!

Two impulse waves are approaching each other, as shown. Which picture correctly shows the total ?



Two impulse waves are approaching each other, as shown. Which picture correctly shows the total ?



Three sinusoidal waves of the same frequency and wavelength travel from left to right. Their amplitudes are y_m, $y_m/2$, $y_m/2$ and their phase constants are 0, $\pi/2$, π, respectively.

What are

(a)The amplitude of the resultant wave?

(b)The phase constant of the resultant wave?

(c)Plot the resultant wave at $t = 0$ and discuss as t increases.

Three sinusoidal waves of the same frequency and wavelength travel from left to right. Their amplitudes are y_m, $y_m/2$, $y_m/2$ and their phase constants are 0, $\pi/2$, π, respectively.

What are

(a)The amplitude of the resultant wave? $y_m/\sqrt{2}$

(b)The phase constant of the resultant wave? $\pi/4$

(c)Plot the resultant wave at $t = 0$ and discuss as t increases Starts at $y_m/2$ and sine propagates to the right