Physics 132 Prof. W. Losert

Outline

Waves

Midterm II FRIDAY

Office hours in Course Center Thursday 1-2 and 5-6.30

Ave: 4.4

Correct	B>C>A=D	F		a) 0, b) Down

The math

- We express the position of a bit of string at a particular time by labeling which bit of string by its *x* position, at x at time *t* the position of the string is $y(x,t)$.
- Since subtracting a *d* from the argument of a function ($f(x) \to f(x-d)$) shifts the graph of the function to the right by an amount *d*, if we want to set the graph of a shape $f(x)$ into motion at a constant speed, we just need to set $d = v_0 t$ and take

$$f(x) \to f(x - v_0 t)$$

Sinusoidal waves

- Suppose we make a continuous wiggle. When we start our clock (t = 0) we might have created shape something like

$$y(x,0) = A\sin kx$$

Why do we need a "*k*"

- If this moves in the +x direction, at later times it would look like

$$y(x,0) = A\sin kx$$

If this moves in the +x direction, at later times it would look like

$$1.\, y(x,t) = A\sin(kx - v_0 t)$$

$$2.\, y(x,t) = A\sin(kx + v_0 t)$$

$$3.\, y(x,t) = A\sin\left[k(x - v_0 t)\right]$$

$$4.\, y(x,t) = A\sin\left[k(x + v_0 t)\right]$$

Sinusoidal waves

- Suppose we make a continuous wiggle. When we start our clock (t = 0) we might have created shape something like

$$y(x,0) = A \sin kx$$

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- If this moves in the +x direction, at later times it would look like

$$y(x,t) = A \sin k(x - v_0 t)$$

Interpretation – Wavelength and Period

$$y = A\sin(kx - \omega t) \qquad\qquad \omega \equiv kv_0$$

Fixed time: Wave goes a full cycle when

$$kx : 0 \to 2\pi$$

$$x : 0 \to \frac{2\pi}{k} \equiv \lambda \qquad \text{(wavelength)}$$

Fixed position: Wave goes a full cycle when

$$\omega t : 0 \to 2\pi$$

$$t : 0 \to \frac{2\pi}{\omega} \equiv T \qquad \text{(period)}$$

How does T, f and ω connect to v_0?

$\omega = k v_0$?

Interpret

$$\omega = 2\pi f = \frac{2\pi}{T} \qquad\qquad k = \frac{2\pi}{\lambda}$$

$$\omega = k v_0 \quad \Rightarrow \quad 2\pi f = \frac{2\pi}{\lambda} v_0 \quad \text{or}$$

$f\lambda = v_0$ (famous wave formula)

Interpret

$$\frac{1}{T}\lambda = v_0 \quad \Rightarrow \quad \lambda = v_0 T$$