Physics 3210

Week 15 clicker questions

The transverse displacement from equilibrium of masses on an elastic string is q_j for mass j. What is the elastic energy of the system of masses, if the spacing between masses is d and the tension is τ?

A. $U = \frac{1}{2}\frac{d}{\tau}\sum_{j=1}^{n+1}\left(q_{j-1} - q_j\right)^2$

B. $U = \frac{1}{2}\frac{d}{\tau}\sum_{j=1}^{n+1}\left(q_{j-1} - q_j\right)$

C. $U = \frac{1}{2}\frac{\tau}{d}\sum_{j=1}^{n+1}\left(q_{j-1} - q_j\right)^4$

D. $U = \frac{1}{2}\frac{\tau}{d}\sum_{j=1}^{n+1}\left(q_{j-1} - q_j\right)^2$

E. $U = \frac{1}{2}\frac{\tau}{d}\sum_{j=1}^{n+1}\left(q_{j-1} - q_j\right)$

In studying the weighted elastic string, we derived the equation

$$K-\omega^2 A=\begin{bmatrix} 2\frac{\tau}{d}-m\omega^2 & -\frac{\tau}{d} & & \\ -\frac{\tau}{d} & 2\frac{\tau}{d}-m\omega^2 & \ddots & \\ & \ddots & \ddots & -\frac{\tau}{d} \\ & & -\frac{\tau}{d} & 2\frac{\tau}{d}-m\omega^2 \end{bmatrix}$$

What is solution for the frequency if n=1 (one mass only)?

A. $\omega=\sqrt{\frac{2\tau}{md}}$

B. $\omega=\sqrt{\frac{\tau}{md}}$

C. $\omega=2\sqrt{\frac{\tau}{md}}$

D. $\omega=\frac{2\tau}{md}$

E. $\omega=\frac{\tau}{md}$

A weighted string consists of regularly spaced masses (mass m, spacing d) connected by string with tension τ. For each normal mode of the motion, all the masses oscillate at frequency ω. What is the spatial dependence of the normal mode amplitude?

A. Constant amplitude for all masses.

B. The amplitude is constant in magnitude but switches sign between adjacent masses.

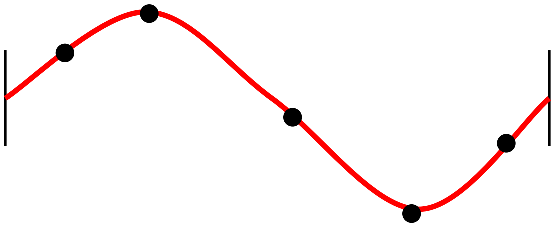
C. The amplitude decays exponentially along the string.

D. The amplitude varies sinusoidally along the string.

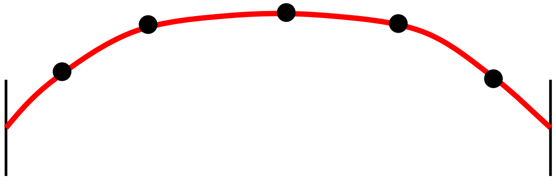
E. The amplitude varies linearly along the string.

A weighted string consists of regularly spaced masses (mass m, spacing d) connected by string with tension τ. For each normal mode of the motion, all the masses oscillate at frequency ω. Which of the normal modes sketched below has the lowest frequency?

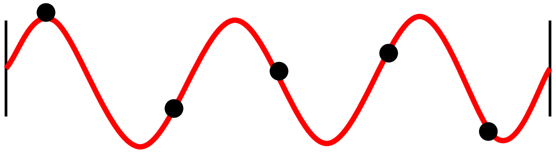
A.



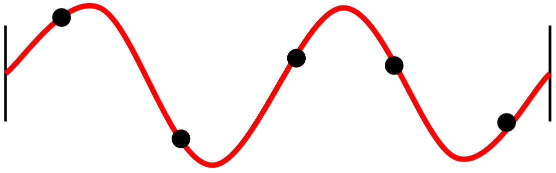
B.



C.



D.



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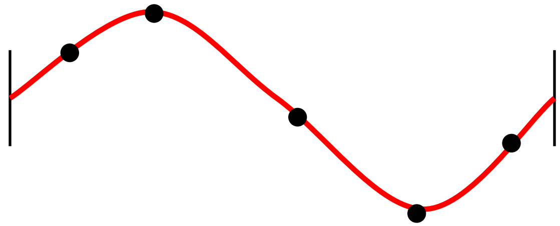
Wednesday clicker questions

A weighted string consists of n regularly spaced masses (mass m, spacing d) connected by string with tension τ. What is the correct limit to take to get a continuous weighted string?



A. $n \to \infty$

B. $m \to 0$

C. $d \to 0$

D. A and C

E. A, B, and C

What is a good approximation to

$$\sin\left(\frac{\ell\pi d}{2L}\right)$$

in the limit $d \to 0$?

A. $\sin\left(\frac{\ell\pi d}{2L}\right) \approx 0$

B. $\sin\left(\frac{\ell\pi d}{2L}\right) \approx \frac{\ell\pi d}{2L}$

C. $\sin\left(\frac{\ell\pi d}{2L}\right) \approx 1-\left(\frac{\ell\pi d}{2L}\right)^2$

D. $\sin\left(\frac{\ell\pi d}{2L}\right) \approx d$

E. $\sin\left(\frac{\ell\pi d}{2L}\right) \approx \frac{\ell\pi}{2L}$

How does the value of the integral depend on m and ℓ?

$$\int_0^L dx \sin\left(\frac{\ell \pi x}{2L}\right) \sin\left(\frac{m \pi x}{2L}\right)$$

A. The integral is zero always.

B. The integral is nonzero always.

C. The integral is zero unless m=ℓ.

D. The integral is nonzero unless m=ℓ.

E. The answer depends on the value of L.

What is a good approximation to

$$\frac{q(x)-q(x+d)}{d}$$

in the limit $d \to 0$?

A. $d\frac{\partial q}{\partial x}$

B. $-d\frac{\partial q}{\partial x}$

C. $\frac{\partial^2 q}{\partial x^2}$

D. $\frac{\partial q}{\partial x}$

E. $-\frac{\partial q}{\partial x}$

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Friday clicker questions