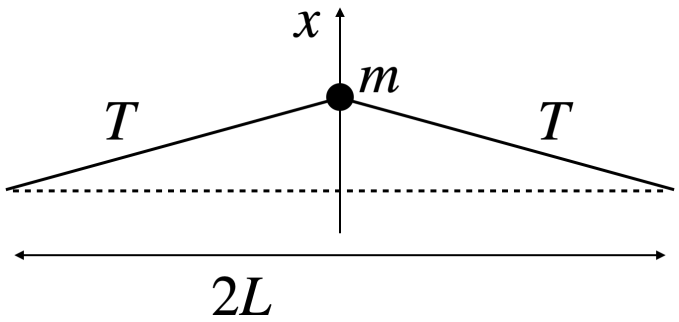
PHYS2063 Wave Physics Homework #2 Due Tuesday 30 Aug 2022

This homework assignment is due at the start of class on the date shown. You may submit a PDF of your solutions to the Canvas page for the course, or bring a paper copy to class.

(1) A bead of mass m sits in the middle of a string with unstretched length $2L$.



The string has tension T and the vertical position of the mass is measured by x. Find the frequency of oscillations for the mass along the x axis, assuming that the amplitude is much smaller than $2L$.

(2) Use Euler's formula to prove that

$$\begin{aligned} & \cos(x+y) &=& \cos(x)\cos(y) - \sin(y)\sin(x) \\ \text{and} \qquad & \sin(x+y) &=& \sin(x)\cos(y) + \cos(x)\sin(y) \end{aligned}$$

(3) An object moves in the xy plane according to the equations

$$x(t) = A_x \cos(\omega t + \phi_x) \qquad \text{and} \qquad y(t) = A_y \cos(\omega t + \phi_y)$$

Plot and describe the shapes of the trajectories when

- $A_x = A_y$ and $\phi_x = \phi_y$
- $2A_x = A_y$ and $\phi_x = \phi_y$
- $2A_x = A_y$ and $\phi_x - \phi_y = \pi/4$

If you make the plots in MATHEMATICA, the function you want to use is ParametricPlot.

(4) Show that, for the series LC oscillator,

$$\frac{d}{dt}\left[\frac{q^2}{2C} + \frac{1}{2}L\dot{q}^2\right] = 0$$

and interpret the meanings of the two terms in square brackets.