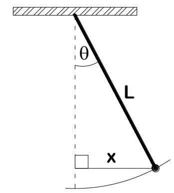
Modeling a Pendulum's Motion **Name(s):**

The horizontal (or vertical) motion of a pendulum may be modeled by $x(t) = A \sin(bt + c)$. We want to understand the relation between A, b and c and the pendulum.



1) Measure out 2m of line and start the pendulum gently swinging. Measure the time for 10 cycles and divide by 10 to get the period (T) in seconds. (T = time for one complete cycle) Note: the frequency is 1/T or f = 1/T. Why?

T = _____________ sec f = ____________ cycles/sec

2) It has long been known that a swinging pendulum's frequency depends on the length of the pendulum with $f(L) = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$ cycles/sec. Using g = 9.8 m/sec^2 compute f and compare with your real data.

using f(L) f = ____________ sec T(L) = _______________ using T(L) T = __________hz

3) Explain how we determine b? b depends on L but it is not the same as f. What is b(L)?

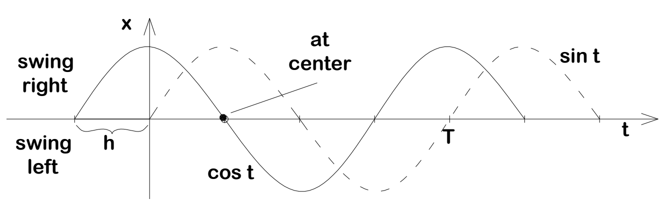
b(L) = _________________ b(2m) = _____________

4) Suppose we start the pendulum by first moving it 20 cm off center. That is, x(0) = 20 cm

(a) How do we determine A? What is it?

5) h depends on T. What is h(T)?

h(T) = __________ ≈ ___________



6) c depends on h. What is c(h)?

c(h) = __________ ≈ ___________

7) Now restart the pendulum by first moving it 30cm off center. That is, x(0) = 30cm. After 5, 10, 15 and 20 swings, record the maximum position of the horizontal displacement.

x(0) = 30 cm x(5T) = _______ x(10T) = ______ x(15T) = ______ x(20T) = ______

Dampened pendulum motion is modeled by $x(t) = A e^{-kt} \sin(bt + c)$. We want to find 'k' 2 ways.

8) Use x(0) and x(5T) to compute 'k' algebraically. You must show your work.

9) Use all 5 data points and run exponential regression to find 'k'. From TI regression: y = ab^x Use change of bases to find 'k'. Solve $b^x \rightarrow e^{-kx}$ for k. You must show your work. Hint: Take ln of both sides.