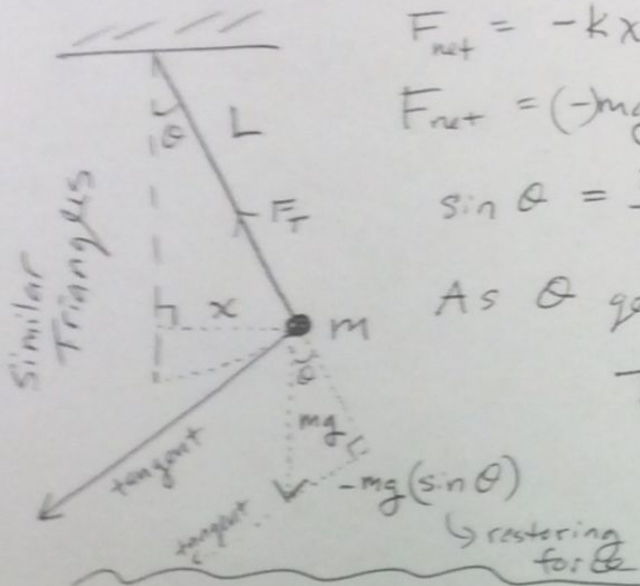
Name:

Pendulums are Simple Harmonic Oscillators



$F_{net} = -kx$ (assume θ is a very small angle)

$F_{net} = (-)mg \sin\theta \Rightarrow mg \cdot \frac{x}{L} = \left(\frac{mg}{L}\right) \cdot x$ ~ K_{eq}

$\sin\theta = \frac{x}{L}$ sinθ is a ratio of triangle sides $\left(\frac{O}{H}\right)$

As θ gets smaller $x \approx$ the arc length.

$T = 2\pi\sqrt{\frac{m}{K_{eq}}} \Longrightarrow \boxed{T = 2\pi\sqrt{\frac{L}{g}}}$

$\frac{m}{K_{eq}} = \frac{m}{mg/L} = \frac{L}{g}$

As $L\uparrow$, $T\uparrow$
As $g\uparrow$, $T\downarrow$

Changing mass or amplitude does NOT change the period!

#1 A ball attached to a chord of length 1.2 m is set in motion so that it swings back and forth. Use $g = 9.81\ m/s^2$

a.) Show that the period of the pendulum is 2.20 seconds:

b.) Explain what must be done to ensure that the motion of the ball approximates simple Harmonic motion.

c.) It is possible to get the ball swinging by holding the top end of the cord and gently swinging it back and forth. Explain how and why this can happen. Use resonance is your answer.

$$T = 2\pi\sqrt{\frac{L}{g}} \quad \text{and} \quad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}} \qquad g = 9.8\ m/s^2$$

#2 Derive a formula for the maximum speed (V_{max}) of a simple pendulum bob in terms of g, L, and angle of swing θ.

#3 What is the period of a simple pendulum 80 cm long on earth?

#4 A .5 meter long pendulum with mass 2 kg is released from rest at $\theta = 20°$. Find X_{max}, V_{max}, a_{max}, T, f, ω & maximum tension.