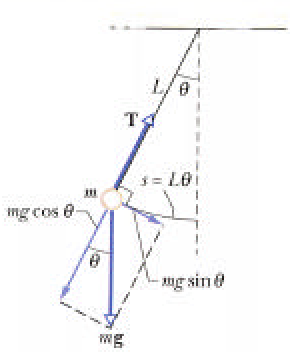
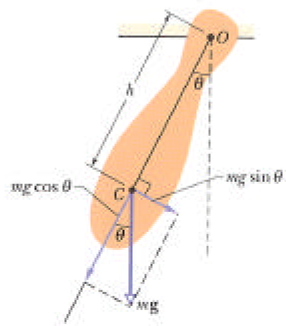
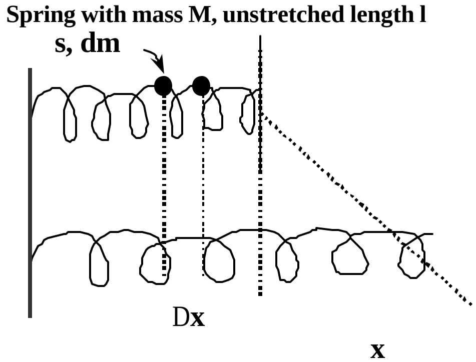
Comments

1) Simple vs. physical pendulums

Simple pendulum	Physical pendulum
	
Rotational $I\frac{d^2\theta}{dt^2} + mgL\theta = 0$ $I = mL^2 \quad \text{mass - string}$ $\ddot{\theta} + \frac{g}{L}\theta = 0$	Rotational $I\frac{d^2\theta}{dt^2} + mgh\theta = 0$ $I \quad \text{has different expressions}$ $\ddot{\theta} + \frac{mgh}{I}\theta = 0$
Linear $m\frac{d^2s}{dt^2} + mg\theta = 0$ $s = L\theta \quad \text{is the displacement}$ $\ddot{\theta} + \frac{g}{L}\theta = 0$ m is a point mass	Linear Cannot use: cannot replace I by m situated at distance h from the point of suspension. Different parts of the body will have different displacements with respect to the equilibrium position

2) Velocity at different points along a spring with mass M



$$\frac{\Delta x}{s} = \frac{x}{l}$$

$$\frac{d}{dt}\frac{\Delta x}{s} = \frac{d}{dt}\frac{x}{l} \quad \Rightarrow \quad \frac{1}{s}\frac{d(\Delta x)}{dt} = \frac{1}{l}\frac{d(x)}{dt} \quad \Rightarrow \quad \frac{1}{s}v_{int} = \frac{1}{l}v_{end}$$

Velocity of any intermediate point on the spring (at distance s from the fixed end) is s/l of end-of-the-spring velocity