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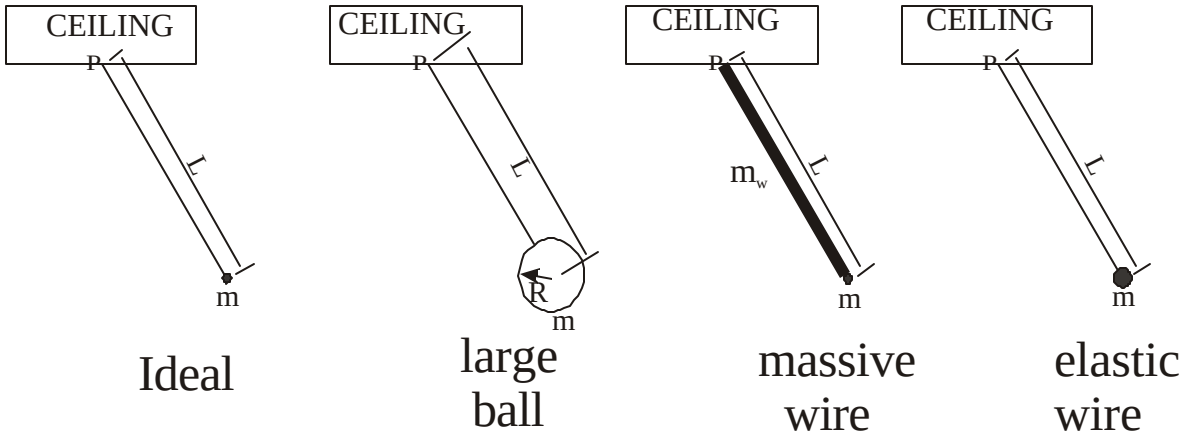
Borough of Manhattan Community College — Course ***Physics 215***

Instructor: ***Dr. Hulan E. Jack Jr.*** — Date **October 31 ,2002**

Quiz 01-03

A simple pendulum ideally consists of a massive object of infinitesmally small dimensions attached at one end of a massless inextensible (will not stretch) string or wire. The cord is attached to a supporting structure at point P. When attempting to determine the effects of non-ideal situations, it is best to take them one at a time. The picture shows the a) the ideal, b) large ball where R that is not infinitesmally small compared to L, c) the wire or string has mass $m_w > 0$, d) the wire or string is elastic with a Young's Modulus M_Y .



1. Massless string or wire, large ball , inelastic (no stretch) wire

R = radius of ball, L = length from support to center of ball

$\tau_P = m\,Lg\,\theta$ $\qquad$ $I_P = mL^2 + 2/5\ mR^2$

$T = T_0\,(1 + 2/5\ (R/L)^2\ )^{½}$, where $T_0 = =2\pi\ (L/g)^{½}$

A Verify that I_P s as given above.

B. Derive the expression for T

2. Massive string or wire , small ball, inelastic (no stretch) wire

m= mass of ball , m_w = mass of wire or string

$\tau_P = (m_w L/2 + mL)g\,\theta$ $I_P = 1/3\, m_w L^2 + mL^2$

$T = T_0 \{((1 + [1/3] [m_w /m]) / (1 + [1/2] [m_w /m])\}^{1/2}$

A. Verify that I_P s as given above.

B. Verify the expression for τ_P

C. Derive the expression for T

3. Massless string, small ball, elastical (stretches) wire

M= mass of ball , L = length from support to center of ball,

M_Y = Young's Modulus of the string or wire material

$\tau_P = mLg\,\theta$ $I_P = mL^2$

$\Delta L = L_0 F/(AM_Y)$ A = cross section area of wire,

F = weight on wire = weight of ball = mg

$T = T_0 (1 + mg/[AM_Y])^{½}$, where $T_0 = 2\pi (L_0 /g)^{½}$

A. Derive the expression for T.