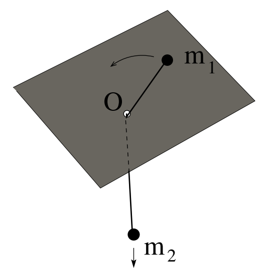
Tutorial III

Classical Mechanics

Course: PH211 + PH403 **Jul-Nov. 2010**

1. Determine (i) the constraint relations and (ii) the degrees of freedom; then (iii) device a set of generalized coordinates, (iv) set up the Lagrangian, and obtain (v) the Lagrange's equations of motion for the following systems:
   (a) double pendulum (treat it as 2-D problem)
   (b) spherical pendulum
   (c) A mass m moves on a parabolic wire $y = c\,x^2$ under gravity. c is a constant (2-D problem).

2. Two masses m_1 and m_2 connected by a light inextensible string of length l. Mass m_1 moves on a horizontal surface, while mass m_2 moves vertically down under gravity as shown in the figure. Set up the Lagrangian of the system and obtain the Euler-Lagrange equations of motion.



3. Show that if $\mathcal{L}(q, \dot{q}, t)$ is a Lagrangian of a system, $\mathcal{L}'(q, \dot{q}, t) = \mathcal{L}(q, \dot{q}, t) + \frac{dF}{dt}$ is also a valid Lagrangian of the system where $F = F(q, t)$ is a differentiable otherwise arbitrary function.

4. A small block of mass m slides down a wedge of angle θ as shown in the figure. The whole motion is in the X-Y plane. Obtain the Lagrange's equations of motion for the following cases:
   (a) the wedge is stationary.
   (b) the wedge (of mass M) is moving on a horizontal surface due to the reaction of the moving mass m.