

Homework 3 - Euler-Lagrange

To be handed in: **ETH:** Mon 12-10-09 **UNI:** Wed 14-10-09

1. **Throwing up a stone** You throw up a stone in vertically in Zurich with an initial velocity v_0 . Where will it fall down?
2. **Lagrangian mechanics**

Consider two homogeneous cylinders with masses m_1 , m_2 and radius r_1 , r_2 , respectively. The upper cylinder is attached to a frictionless axis while the lower one is falling in the gravity field. A massless string is wound up on both cylinders in such a way that it unwinds as the lower cylinder is falling (see Fig.1).

 - (a) Compute the moment of inertia of the cylinders I_i .
 - (b) Write down the Lagrangian $L = L(\varphi_i, \dot{\varphi}_i)$
 - (c) Find the equations of motion using the Euler-Lagrange equations.
 - (d) Solve the equations of motion and compute the velocity $z(t)$ of m_2 as a function of time.

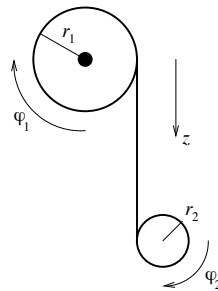


Figure 1: The upper cylinder is turning about a fixed axis, the lower one is falling. The two cylinders are wound up by a string.