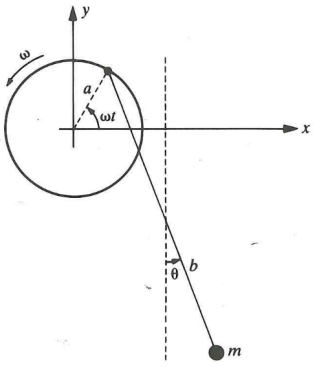
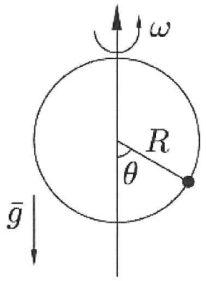
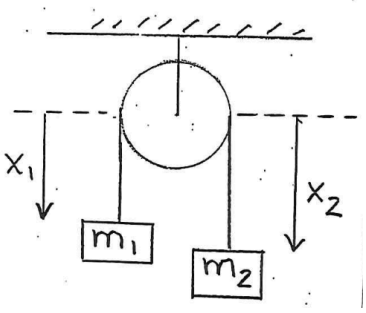
Classical Mechanics TFY 4345 – Exercise 3 (lecture hours 9-12)



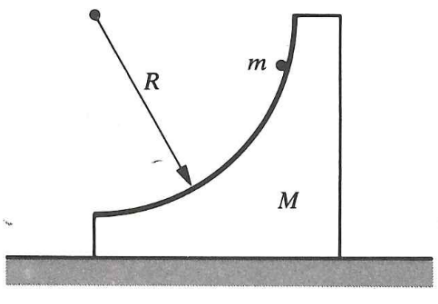
1. The point of support of a simple pendulum of length *b* moves on a massless rim of radius *a* rotating with a constant angular velocity ω. Obtain the expression for the Cartesian components of the velocity and acceleration of the mass *m*. Obtain also the angular acceleration for the angle θ shown in the figure by using Lagrange's equation.



2. A bead is attached to a ring with radius *R* where it can slide frictionless. The ring itself is attached to vertical shaft which rotates with a constant angular velocity (let us assume that the shaft does not affect the bead motion). Obtain by using the Lagrange equations the equilibrium position of the bead.



3. Atwood's machine: Determine the Hamiltonian and Hamilton's equations of motion for a simple Atwood's machine (single pulley). The pulley radius is *a* and the moment of inertia *I*.



4. A particle of mass *m* slides down a smooth circular wedge of mass *M* as shown in the figure. The wedge rests on a smooth horizontal table with coordinate *x*. Find (a) the equation of motion of *m* and *M* and (b) the reaction of the wedge on *m*.

Note: This one is tedious, focus on the other 3 first!

Hint: Use the method of Langrange's undetermined multipliers. Select *x* and θ as generalized coordinates.