

Problem Set 2 – due September 22

1. A uniform flexible rope of length ℓ is suspended above the ground between two supports of the same height, a distance $2x_0 < \ell$ apart. Assume that the supports are high enough that the rope does not touch the ground. Find the shape of the rope that minimizes the potential energy. (10 points)

Use the constrained Lagrangian method for the next two problems.

2. A mass m attached to a flexible string of length L hangs vertically at rest in a gravitational field g . It is given a horizontal impulse and begins to rotate at angular velocity ω . Show that (a) if $\omega^2 < 2g/L$ then the mass does not reach the horizontal and the tension in the string is never zero. (b) if $2g/L < \omega^2 < 5g/L$, the mass passes the horizontal but the string becomes slack before the mass comes to rest. (c) if $\omega^2 > 5g/L$, the mass rotates periodically and the string remains taut. (15 points)
3. A ladder is inclined in a corner against a frictionless wall and floor, and begins to slide down under gravity. Show that the ladder loses contact with the wall when the top of the ladder has fallen to $2/3$ of its original height. What is the subsequent motion of the ladder? (15 points)