1. Mass m hangs on a massless rope in a car moving with (a) constant velocity $\mathbf{v}$, (b) constant acceleration $\mathbf{a}$ on a horizontal surface. What is the angle the rope forms with the vertical direction

2. Discuss the previous problem if the car slides (without friction) down a plane inclined at an angle α.

3. A monkey with mass m holds a rope hanging over a frictionless pulley attached to mass M (see figure). Discuss motion of the system if the monkey

    (a) does not move with respect to the rope,

    (b) climbs up the rope with constant velocity $\mathbf{v_0}$ with respect to the rope,

    (c) climbs up the rope with constant acceleration $\mathbf{a_0}$ with respect to the rope.
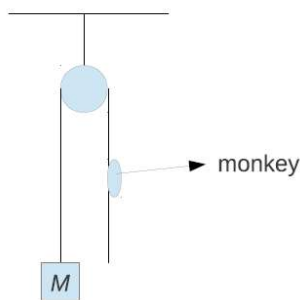
7. Consider fall of an object (mass m) without initial speed. Assuming quadratic air drag find the time dependence of object's velocity and position. Find the terminal speed.

8. A particle falls on the Earth from a high altitude h. Neglecting air drag, find the time T when it hits the ground and the speed it has at this instant (I may put it on the problem set).

10. Discuss motion of a particle that is placed on the inner surface of a spherical pot, close to its bottom, and released from hold (no friction).

11. (more difficult) The same for a pot with cross-section in the shape of a cycloid placed upside-down

$$x = R(\gamma + \sin\gamma), \qquad y = R(1 - \cos\gamma),$$

where $-\pi \le \gamma \le \pi$.