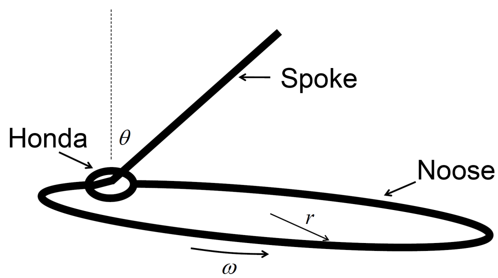
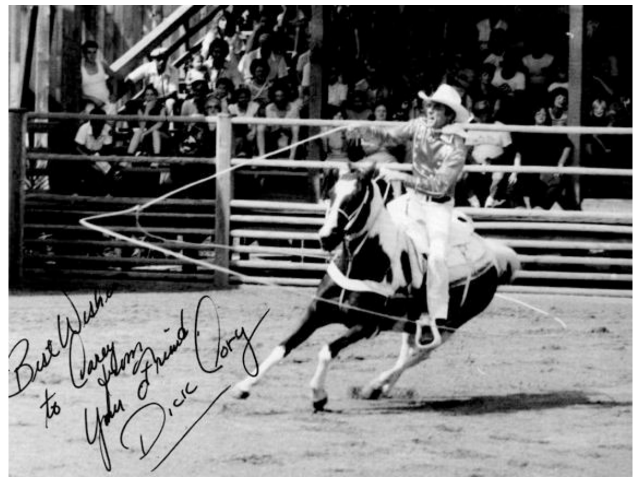
Section A. Mechanics

1. (Lasso)





Picture from: "The Lasso: a rational guide ..." ©1995 Carey D. Bunks

A ***lasso*** is a rope of linear mass density ρ that ends in a loop called the ***honda***. The free end of the rope is fed through the honda to create a large loop called the ***noose***. The remaining length of rope is called the ***spoke***, which is used to impart energy to the noose (spin it up) and to support it against the downward pull of gravity.

Consider the case of a circular noose of radius r spinning in a nearly horizontal plane with angular speed ω (you can neglect the tilt angle of the noose with respect to the horizontal). The spoke is supported above the center of the noose and makes an angle θ with respect to the vertical. There is no friction between the rope and the honda.

a) What is the tension in the rope within the loop?

b) The inward force of the spoke on the honda tends to perturb the shape of the noose near the honda (*as can be seen in Dick Cory's picture, above*). To counteract this effect, the honda is given an additional mass m_{h} (say, by wrapping it with a heavy metal wire). What should m_{h} be in terms of the given quantities in order to maintain the circular shape of the noose?

c) Suppose the spinning noose is subject to a small-amplitude transverse disturbance (a kink) that results in a wave propagating along the rope in the direction opposite to the rotation of the noose. What is the angular speed of the wave as viewed from a reference frame at rest with respect to the spinning noose? What does your answer imply about the motion of the kink as seen by an observer in the fixed frame?