Problem Set 5: Universal Law of Gravitation; Circular Planetary Orbits

Design Engineering Challenge: "The Big Dig" 2.007 Contest
Evaluation of Scoring Concepts: Spinner vs. Plower

For the Spring 2004 contest table ("The Big Dig", see http://pergatory.mit.edu/2.007) the spinable platter contains shot-puts and street-hockey balls. Here we will compare the concepts of spinning the platter vs. direct pushing/pulling to liberate the balls

1. Draw a free-body-diagram of a sphere in a hole, like is used to hold the shot-puts and the balls.
2. What is the force condition for making a ball or shot-put to just rise up out of the hole?
3. What is the force condition for making a ball shot-put to leave the hole and start rolling across the platter?
4. What angular velocity of the platter must be achieved in order to meet the force conditions in (3)?
5. How hard would a "lasso" have to pull (or a blade to push) in order to meet the force conditions in (3)?
6. What is a better concept for liberating the shot-puts or hockey balls, spinning the platter or pulling or pushing them off?
7. How do considerations of machine design complexity and feasibility affect the overall best concept?