8.012 Physics I: Classical Mechanics
Fall 2008

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.012: Physics (Mechanics) I **Fall Term 2008**

PROBLEM SET 7

Collaboration policy: You are encouraged to freely discuss homework problems with other 8.012 students and teaching staff. However, **you must write up your solutions completely on your own**—do not simply copy solutions from other students. You are **forbidden from consulting solutions from previous years or from the web.** Violations of this policy may result in disciplinary action.

Reading: Kleppner & Kolenkow, Chapters 6 & 7

0. **Collaboration and discussion.** Please list the names of all the students with whom you discussed these homework problems. Also be sure to write down your name and recitation section clearly on the first page.
1. Kleppner & Kolenkow, Problem 6.8 [10 points]
2. Kleppner & Kolenkow, Problem 6.13 [5 points]
3. Kleppner & Kolenkow, Problem 6.16 [10 points]
4. Kleppner & Kolenkow, Problem 6.18 [5 points]
5. Kleppner & Kolenkow, Problem 6.21 [10 points]
6. Kleppner & Kolenkow, Problem 6.24 [10 points]
7. Kleppner & Kolenkow, Problem 6.29 [10 points]
8. Kleppner & Kolenkow, Problem 6.30 [5 points]
9. Kleppner & Kolenkow, Problem 6.34 [10 points]
10. Kleppner & Kolenkow, Problem 6.35 [10 points]

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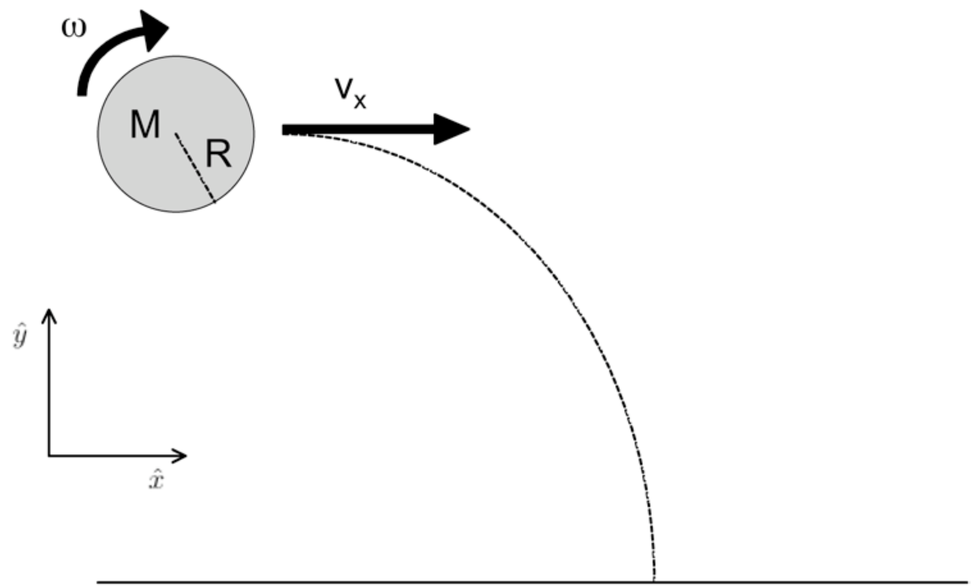
11. **Superball Bounce.** [15 points]



A superball of mass M, radius R and uniform density is thrown with horizontal velocity v_x and rotation rate ω (assume that the spin angular momentum vector is orthogonal to the trajectory of the ball). The ball makes a perfectly elastic "bounce" on the floor without slipping, in a manner such that the magnitude of its vertical velocity is the same before and after the bounce (i.e., it would bounce to the same height from which it was originally released).

(a) [10 pts] Calculate the horizontal velocity and rotation rate of the ball immediately after the bounce, in terms of the v_x, ω and R.

(b) [5 pts] Calculate the horizontal velocity and rotation rate immediately after a second bounce, in terms of the original v_x, ω and R. Based on this answer, can you describe the motion of the ball after many bounces? (You are encouraged to confirm your answer by experimentation).