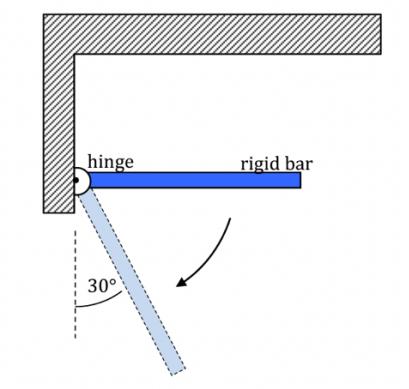
Physics 247: Rotational Dynamics 1

1) A rigid bar with a mass M and length L is free to rotate about a frictionless hinge at a wall. The bar is released from rest when it is in a horizontal position as shown. What is the instantaneous angular acceleration when the bar has swung down so that it makes an angle of 30° to the vertical?



2) For the same bar what is the angular velocity and tangential velocity of the end of the bar furthest from the hinge at the same position as in problem 1.

3) A hoop and a solid disk both radius, R, and mass, M are rolling without slipping along a flat surface with velocity v. A solid cube mass, M, with sides length R is sliding across the plane with no friction also with velocity v. All three objects start to roll (or slide for the cube) up a hill. Derive 3 equations for the height, h, above the flat surface, each object gets to on the hill before stopping. Make sure the equations make the heights easy to compare. Which object gets to the highest point.

(Problem 4 next page)

4) Step ladder problem.
A lightweight step ladder (the ladder's mass can be consider negligible) is setup on a frictionless surface such that.
The two sides of the ladder are at the same magnitude angle relative to the ground.
Each side of the ladder is 4m long and there is a cross bar located midway up the ladder.
The distance between the two sides of the ladder on the ground is 2m and 1m at the cross bar.
The ladder is hinged at the top such the two sides can rotate independently.
A 70kg man stands 3 meters up one side of the ladder. The whole system is static.
(See diagram)
Find the tension in the cross bar.