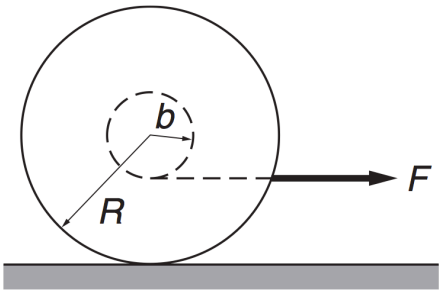
Tutorial 2

Problem 1. (K & K. Ex 7.27) A yo-yo of mass M has an axle of radius b and a spool of radius R. Its moment of inertia can be taken to be $MR^2/2$. The yo-yo is placed upright on a table and the string exerts a horizontal force F on the yo-yo as shown. The coefficient of friction between the yo-yo and the table is μ.

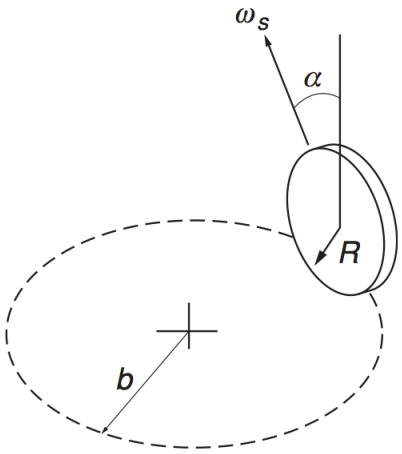


1. Without doing any calculation, in which direction do you expect the yo-yo to start rotating and rolling?

2. Determine the linear acceleration $\boldsymbol{a}$, assuming that the yo-yo rolls without slipping.

3. What is the maximum value of F for which the yo-yo will roll without slipping?

Problem 2. (K. & K., Ex. 8.6) A coin of radius R and mass M rolls on a horizontal surface at speed V. If the plane of the coin is vertical the coin rolls in a straight line. If the plane is tilted, the path of the coin is a circle of radius b. Find an expression for the tilt angle of the coin α in terms of the given quantities. (Because of the tilt of the coin the circle traced by its center of mass is slightly smaller than b but you can ignore the difference.)


ω_s
α
R
b