

Problem 1

Excentric wheel

a) Prof. Dr. M. Bartelmann – *Uni Heidelberg*

b) Markus Schmitt Uni Göttingen

Background A cylindrical disk with radius R_1 and density ρ_1 has a smaller cylindrical disk with radius $R_2 < R_1$ and equal thickness d excentrically inserted. The density of the smaller disk is $\rho_2 > \rho_1$, and its centre is at a distance a from the centre of the larger disk. In other words, we have a lop-sided wheel.

a) [8 points] Set up the Lagrange function for the wheel rolling on a horizontal plane, and derive the equation of motion.

b) [2 points] You are given two discs with radii $R_{1/2}$ and densities $\rho_{1/2}$ and asked to build a clock. At which excentricity a do you have to insert the small disc into the large in order for the composite object to oscillate with a desired period T at small displacements from the rest position?

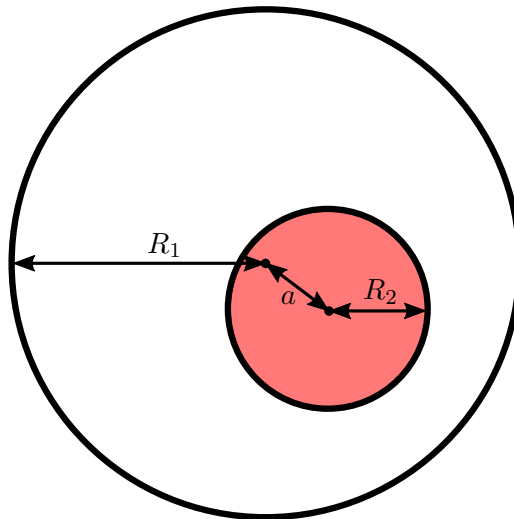


Figure 1 Schematic sketch of the excentric wheel.