Homework #8: Phys 4321: Prof. Olness Spring 2025

1) Find the shortest distance between two points located on the surface of a cylinder.

2) Solve the brachistochrone as outlined in the book (your choice). Add in all the intermediate steps. (Most books leave out quite a bit. I want to see the trig substitutions and integration done by hand!) Plot the resulting curves.

3) Consider light passing from one medium to another with indices of refraction of {n1,n2}. Use Fermat's principle to minimize the time and find the resulting law of refraction.

4) Consider a hoop of mass m and moment of inertia $I=m R^2$ sliding down an incline of angle ϕ a distance x (along the incline). The hoop rolls WITHOUT slipping.. Do this using the Lagrange equations.
a) First do this WITHOUT the Lagrange multiplier λ ,
by using: $R\theta - x=0$.
b) Second, do this WITH the Lagrange multiplier λ , and use the constraint equation: $R\theta - x=0$.