A car begins moving on a horizontal road, with a door accidentally left open with an initial angle ϕ_0 (where $\phi = 0$ indicates the door is closed). The straight-line motion of the car is described by a function $X(t)$. The door has mass M, width W, height H, and negligible thickness. Assume that the hinges allow a full rotation of the door in $\pi > \phi > -\pi$ interval.

1. Write the Lagrangian of the door, considering it as a rotating rigid body.

2. Find a differential equation for the angle of the door ϕ in terms of the known $X(t)$.

3. Under what condition can the door have small oscillations about an equilibrium position? What would the frequency of these oscillations be?