In a mill, grain is ground by a massive wheel that rolls without slipping in a circle on a flat horizontal mill stone driven by a vertical shaft. The rolling wheel has mass \( M \), radius \( b \) and is constrained to roll in a horizontal circle of radius \( R \) at angular speed \( \Omega \). The wheel pushes down on the lower mill stone with a force equal to twice its weight (normal force). The mass of the axle of the wheel can be neglected. Express your answers to the following questions in terms of \( R \), \( b \), \( M \), \( \Omega \), and \( g \) as needed. The goal of this problem is to find \( \Omega \).

a) What is the relation between the angular speed \( \omega \) of the wheel about its axle and the angular speed \( \Omega \) about the vertical axis?

b) Find the time derivative of the angular momentum about the joint (about the point \( P \) in the figure above) \( dL_P / dt \).

c) What is the torque about the joint (about the point \( P \) in the figure above)?

d) What is the value of \( \Omega \)?