May 1975 – Closed Book – Oral Exam

A rather unusual angular velocity monitoring device is modeled as shown in the accompanying sketch. It consists of a uniform bar of weight \( w \) and length \( l \) that is constrained to remain in the plane as the center spindle rotates. The bar is supported at its center by a cord of length \( s \) that is attached to the spindle. Draw a free-body diagram of the bar. Assuming the bar-spindle contact is frictionless, find the relationship between the output angle \( \theta \) and the input angular velocity \( \omega \).

What is the contact force between the bar and the spindle?