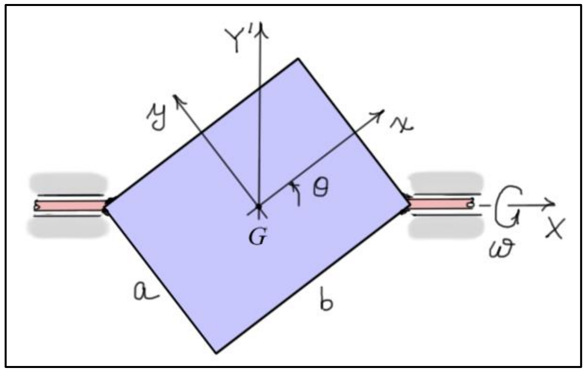
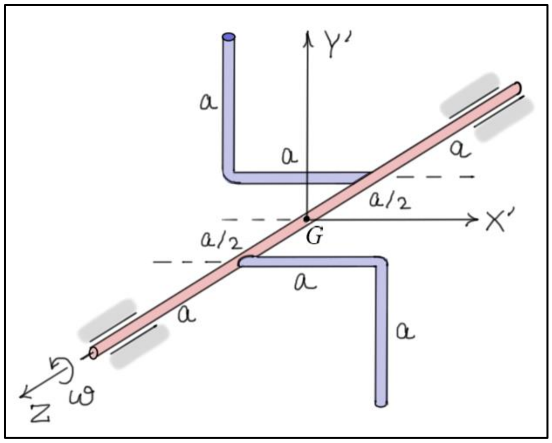
Intermediate Dynamics
Exercises #7

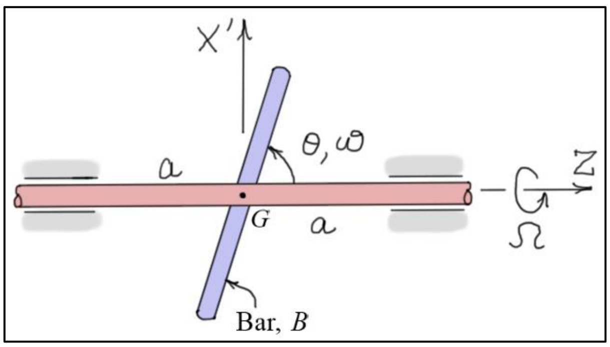
1) A thin rectangular plate P of mass m is welded to a shaft, so it rotates about its diagonal as shown. Given that the plate has angular velocity ω and angular acceleration α, find: (a) the bearing loads at the ends of the plate, and (b) the driving torque T. Assume that the bearing loads are concentrated near the corners of the plate. Express the results in the X, Y', and Z' shaft-fixed directions.



2) The system shown consists of two L-shaped arms welded to a shaft of length $3a$. Each length a has mass m. The planes of the arms are at right angles to the shaft. Given the system has angular velocity ω and angular acceleration α, find: (a) the bearing loads at the ends of the shaft, and (b) the driving torque T. Assume all parts are made of "slender" bars. Express the results in the X', Y', and Z shaft-fixed directions.



3) The system shown consists of a bar B of length ℓ and mass m that is pinned through the center of a shaft of length $2a$. As the shaft rotates about the Z-axis at a constant rate Ω (rad/sec), B rotates about the Y-axis at a rate $\dot{\theta} = \omega$ (rad/sec). (a) Find the moments that are transmitted (in the X' and Z directions) through the pin at G. (b) Find the differential equation of motion governing the angle θ.



4) The system shown consists of a bar B of length ℓ and mass m that is pinned to the bottom of a disk D. As the disk rotates at a ***constant rate*** Ω (r/s) about the Z-axis, the bar rotates at a ***non-constant*** rate $\dot{\theta}$ (r/s) about the X'-axis. When the system is at rest, the bar hangs downward under the action of gravity. (a) Find the ***bar-fixed*** force and moment components transmitted through the pin at P. (b) Find the differential equation of motion governing the angle θ.