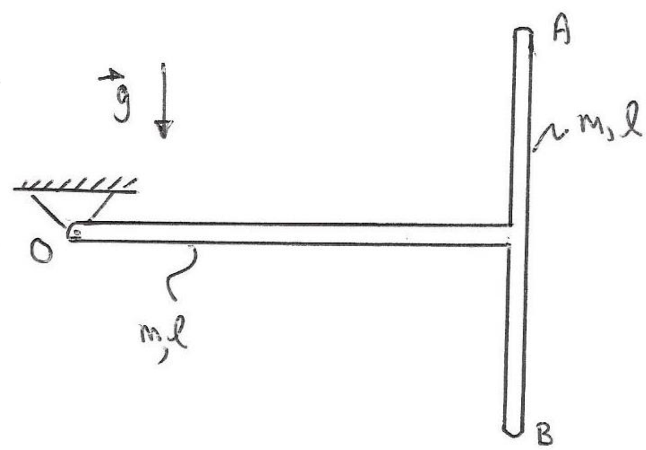
ME 104 – Spring 2023
Midterm Exam 2

Print and sign your name here:

Important: Report all requested vector quantities as vectors. In other words, do not just report the magnitude of a vector quantity, report its direction as well in your final answer.

[1] (50%) The rigid body below consists of two slender rods each of mass *m* and length *l* that are welded at a right angle to form a T-shape. The end *O* is a frictionless pivot. The rigid body is release from rest when *AB* vertical and gravity acts downwards. Recall that the moment of inertia of a slender rod about its mass center is $ml^2/12$.



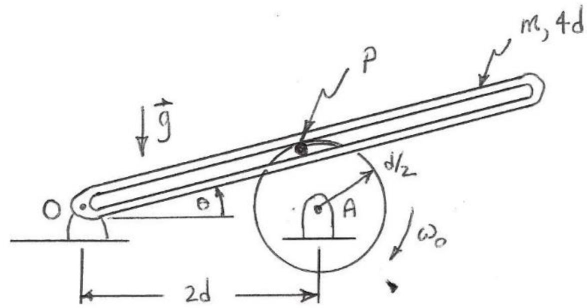
(a) (10 pts) Compute the mass moment of inertia of this rigid body about its mass center.

Regardless of your answer to (a), now let the moment of inertia about the mass center be denoted by the symbol I_c in the next two questions. In other words, do not use your answer to (a) when answering (b) and (c) below, just use the symbol I_c if/when needed.

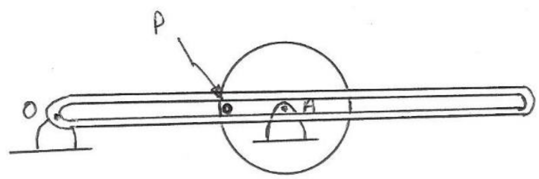
(b) (20 pts) Compute the angular acceleration of the rigid body at the instant of release.

(c) (20 pts) Compute the reaction force at *O* at the instant of release.

[2] (50%) The mechanism below consists of a disk of radius *d/2* that rotates with constant clockwise angular speed ω_o. Fixed to the perimeter of the disk is a pin *P* that slides without friction in a slotted arm. Treat the slotted arm as a uniform slender rod of mass *m* and length *4d* that rotates about *O* (a frictionless bearing). The mechanism moves in the vertical plane. Recall that the moment of inertia of a slender rod about its mass center is $ml^2/12$ where *l* is the length of the rod.



Consider the instant when $\theta = 0$ with the pin P closest to *O* as shown below.



For this instant when $\theta = 0$:

(a) (10 pts) Compute the velocity of the pin *P*.

(b) (20 pts) Compute the angular velocity of the slotted arm.

Regardless of your answer to (b), now let the angular velocity of the slotted arm be denoted by $\omega_{arm}\widehat{K}$ for the next question. In other words, do not use your answer to (b) when answering (c), just use the quantity $\omega_{arm}\widehat{K}$ if/when needed.

(c) (20 pts) Compute the reaction force at *O*.