ME 104, 5/8/2002
University of California, Berkeley
Test Number Three
Tongue

READ THIS! ⇒ Remember to follow the hw format conventions. Explicitly state what you're solving for and how. Box your answers. Demonstrate clearly that you know what you're doing - don't leave me guessing. Make sure you adequately explain your reasoning. And please don't assume that the problem is harder than it seems. Sometimes I'm asking something simple and, if you can give me the correct answer without a lot of calculation, then do so and move on.

1. Shown in Figure 1 is a model of a car similar to the one that you looked at as a homework problem. For this case, the moment applied from the bar to the wheel is applied in a clockwise manner - not counterclockwise. The interface at C is friction-free. Determine the acceleration of the vehicle is after M is applied. Assume roll without slip. $r = 0.4$ m, $m_1 = 2$ kg, $L = 1.2$ m, $m_2 = 2.2$ kg and the moment applied from $\overline{AB}$ to the wheel is given by $\underline{M} = -15$ N·m $\underline{n}_3$. Treat the link $\overline{AB}$ as a thin, rigid bar. The support rod $\overline{BC}$ has negligible mass. (rigid body kinetics - 41 pts)

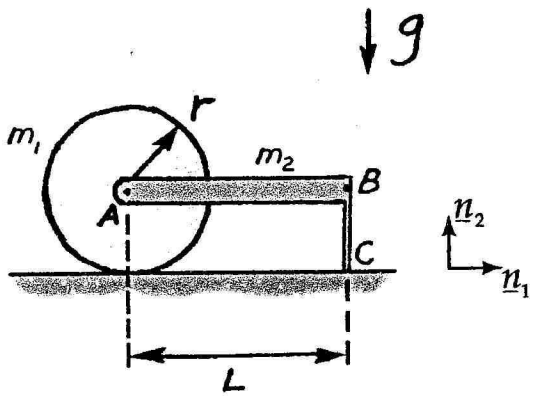

Figure 1:

2. Shown in Figure 2 is a boat, initially traveling at 4 m/s in the $\underline{n}_1$ direction. In order to go faster, the captain decides to fire a couple of cannonballs in the $-\underline{n}_1$ direction, on the assumption that the reaction will push them to the right. The captain and the first mate disagree about how to go about it. The captain thinks that firing both cannons simultaneously will give them the greatest speed. The first mate, on the other hand, feels that by firing the starboard cannon first, followed by the port cannon, they'll go a tiny bit fast than if they fire both simultaneously. Your job is to determine if either person is correct or if there's actually no difference. Assume that for each case the cannonball(s) are moving faster than the cannon by 200 m/s as they exit the muzzle. The cannon and boat have a combined mass of 2000 kg and each cannonball has a mass of 5 kg. Assume that the boat continues moving in the x direction for all cases (i.e. ignore any off-axis moments that might cause the boat to pitch or yaw). (linear momentum of multiple particles- 25 pts)

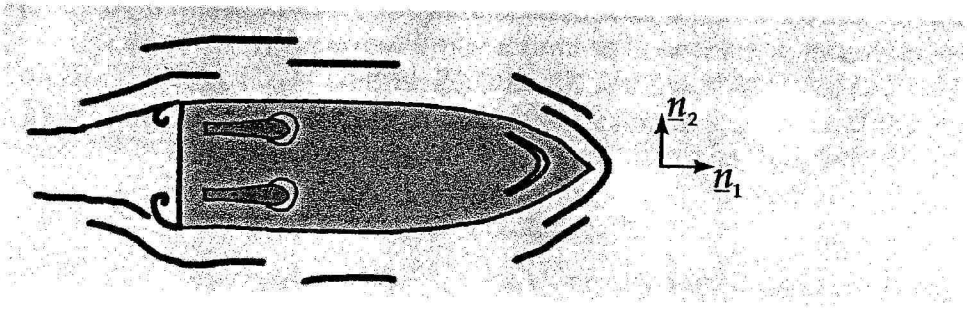

Figure 2:

3. The object illustrated in Figure 3 is a rigid L-shaped link, pinned at O and constrained to move along a vertical guide at B (a small wheel extends from B and into the guide). The guide at B moves to the right at a constant speed $\dot{x} = v_0$. What is the angular acceleration of the L-shaped link? At the illustrated instant $\theta = 60°$. $\overline{OA} = 0.5$ m and $\overline{OB} = 3.0$ m. (rigid body kinematics - 34 pts)

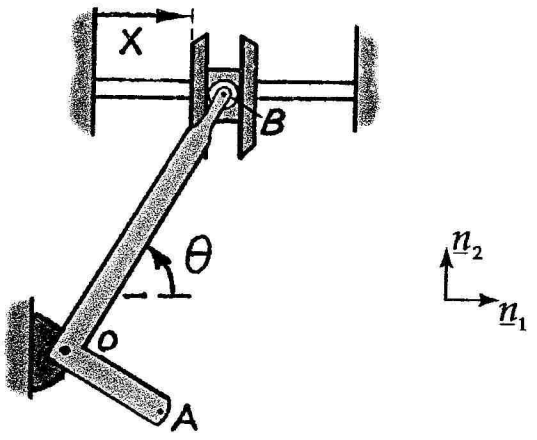

Figure 3: