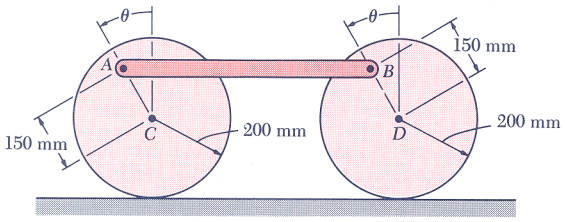
Review Problems - Final Exam

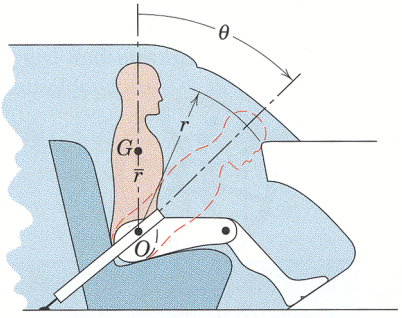
1. The 8 kg rod AB is attached by pins to two 5 kg uniform disks as shown. The assembly rolls without sliding on a horizontal surface. If the assembly is released from rest when θ=60 deg, determine
   a) the angular velocity of the disks when θ=180 deg
   b) the force exerted by the surface on each disk at that instant

   (taken from Dynamics by Beer and Johnston, Fifth Edition)



ans: $\overline{w} = 8.44\ rad/s\ CCW, \quad \overline{N} = 122.5\ N \uparrow$

2. In a study of head injury against the dashboard of a car during sudden or crash stops where lap belts without shoulder straps are used, the segmented human model shown in the figure is analyzed. The hip joint O is assumed to remain fixed relative to the car and the torso above the hip is treated as a rigid body of mass *m* pinned at O. The center of mass of the torso is at G with the initial position of OG taken as vertical. The radius of gyration about O is k_O. If the car is brought to a stop with a constant deceleration *a*, determine the velocity *v* relative to the car with which the model's head strikes the dashboard. Substitute the values:



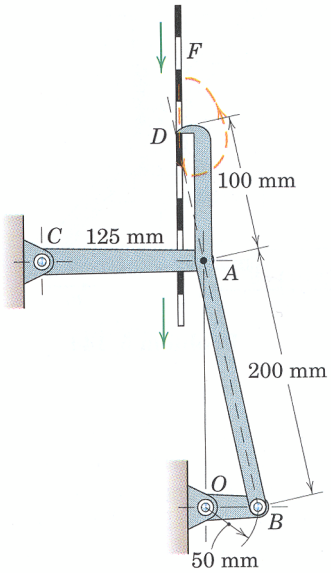
$m = 50\ kg \qquad \bar{r} = 450\ mm \qquad r = 800\ mm \qquad k_O = 550\ mm \qquad q = 45^\circ \qquad a = 10g$

(taken from Dynamics by Meriam and Kraige, Fourth Edition)

Hint: $I_O = I_G + m\bar{r}^2$

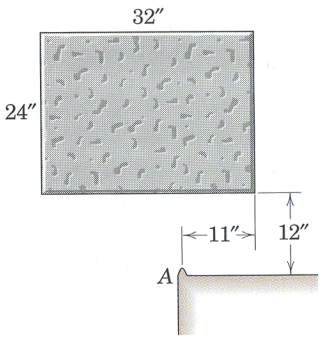
ans: $v = 11.73\ m/s$

3. An intermittent-drive mechanism for a perforated tape F consists of the link DAB driven by the crank OB. The trace of the motion of the finger at D is shown by the dashed line. Determine the magnitude of the acceleration of D at the instant shown when both OB and CA are horizontal. Crank OB has a constant clockwise angular velocity of 120 rpm.
(taken from Dynamics by Meriam and Kraige, Fourth Edition)



ans: $a_D = 1997\ mm/s^2$

4. The uniform concrete block, which weighs 171 lb and falls from rest in the horizontal position shown, strikes the fixed corner A and pivots around it with no rebound. Calculate the angular velocity of the block immediately after it hits the corner and the percentage loss *n* of energy due to the impact.
(taken from Dynamics by Meriam and Kraige, Fourth Edition)



ans: $\overline{w} = 1.593\ rad/s\ CCW, \quad n = 91.7\%$