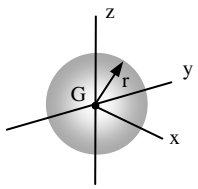
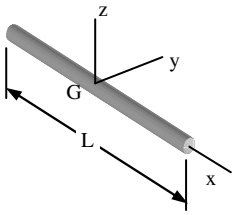
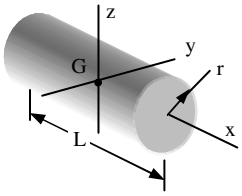
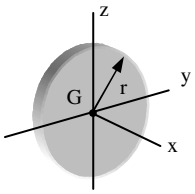
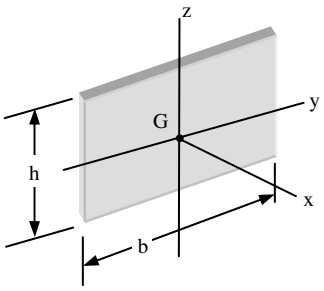
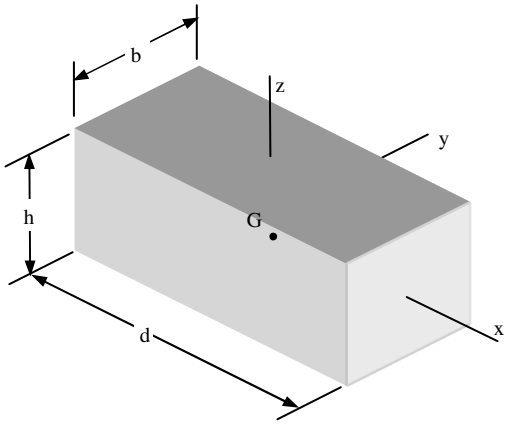
**Name** _____ **Section** _____

**ES204**
Examination II
January 18, 2008

| Problem | Score |
|---|---|
| 1 | /30 |
| 2 | /30 |
| 3 | /40 |
| Total | /100 |

Show all work for credit
AND
Turn in your signed help sheet
AND
Stay in your seat until the end of class

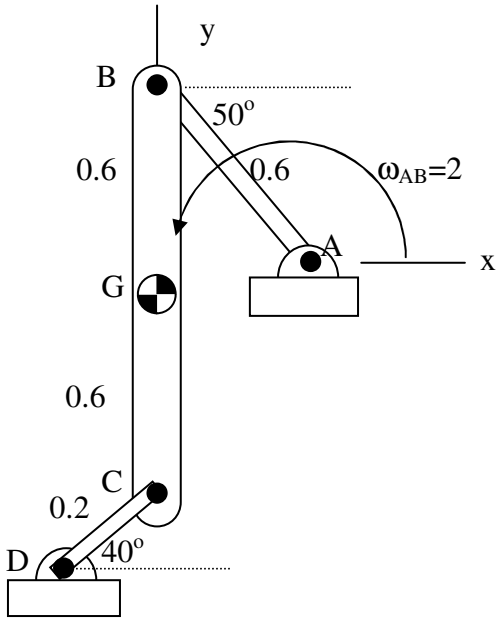
# Mass Moments of Inertia

| | |
|---|---|
| Solid Sphere<br>$I_x = I_y = I_z = \frac{2}{5}mr^2$ |  |
| Slender Rod<br>$I_y = I_z = \frac{1}{12}mL^2$ |  |
| Solid Circular Cylinder<br>$I_x = \frac{1}{2}mr^2$<br>$I_y = I_z = \frac{1}{12}m\left(L^2 + 3r^2\right)$ |  |
| Thin Disk<br>$I_x = \frac{1}{2}mr^2$<br>$I_y = I_z = \frac{1}{4}mr^2$ |  |
| Thin Rectangular Plate<br>$I_x = \frac{1}{12}m\left(b^2 + h^2\right)$<br>$I_y = \frac{1}{12}mh^2$<br>$I_z = \frac{1}{12}mb^2$ |  |
| Brick<br>$I_x = \frac{1}{12}m\left(b^2 + h^2\right)$<br>$I_y = \frac{1}{12}m\left(h^2 + d^2\right)$<br>$I_z = \frac{1}{12}m\left(b^2 + d^2\right)$ |  |

Name _____ 30 pts

ES204 Examination II **Problem 1** Jan. 18, 2008

Link AB is 0.6 m in length. The link connecting BC has length of 1.2 m. CD's length is 0.2 m. The mass center of BC, G, is halfway between B and C, as indicated. The link AB is rotating counter-clockwise at 2 rad/s.




For the configuration shown, calculate the following:

a) The angular velocity of BC, $\omega_{BC}$.

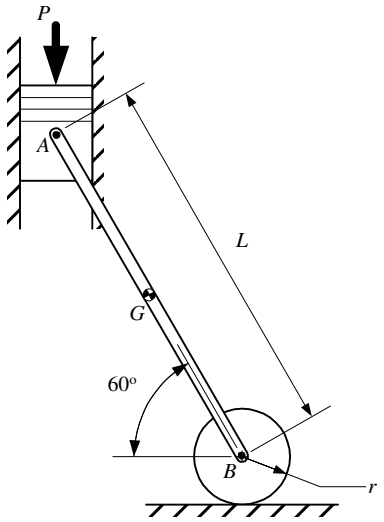
b) The angular velocity of link CD, $\omega_{CD}$.

Name _____ 30 pts

ES204 Examination II **Problem 2** Jan. 18, 2008

A constant force P is applied to piston A as it causes uniform cylinder B to roll without slip via slender homogeneous rod AB. The system is initially at rest in the vertical plane. Set-up, but do not solve, a set of equations and unknowns required to find the angular speed of cylinder B when the rod angle changes from $60^o$ to $0^o$ with respect to the horizontal. Friction between piston and cylinder walls may be neglected.

Known: P, $m_A$, $L$, $m_{AB}$, $r$, $m_B$.



Name _____ 40 pts

ES204 Examination II **Problem 3** Jan. 18, 2008

A javelin (which can be modeled as a slender rod) of mass $m_J$ and length $L_J$ is thrown into a light bar of mass, $m_B$ and length, $L_B$ as shown. The javelin sticks in the end of the rod. Assume the javelin does not penetrate very far into the rod. Immediately before the impact the angular velocity of the bar is $\omega_0$ and the velocity of the javelin is $v_0$. Determine the equations necessary to find

a) the reactions at C immediately **before** the impact
b) the angular velocity of the rod and javelin **after** the impact.

**Do not solve the equations**. Your solution should consist of a clear list of equations and unknowns. Assume $\omega_0$, $m_B$, L, $m_J$, $L_J$ and $v_0$ are known.