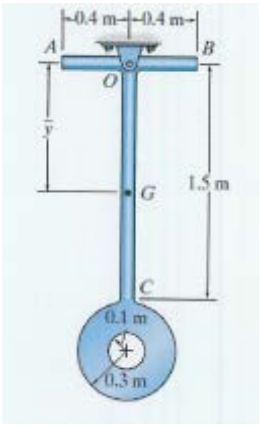
# EGM 3420C - Engineering Mechanics
## Dynamics Review Problems

Problem 15. The pendulum consists of two slender rods ***AB*** and ***OC*** which have a mass of 3 kg/m. The thin plate has a mass of 12 kg/m$^2$. Determine the location $\bar{y}$ of the center of mass ***G*** of the pendulum, then calculate the moment of inertia of the pendulum about the axis perpendicular to the page and passing through ***G***.




$MASS_{AB} = 0.8(3) = 2.4\ kg$

$MASS_{OC} = 1.5(3) = 4.5\ kg$

$MASS_{DISK} = 12(\pi)(.3)^2 = 3.39\ kg$

$MASS_{HOLE} = 12(\pi)(.1)^2 = 0.377\ kg$

| SHAPE | MASS (kg) | $\tilde{y}$ m | $\tilde{y}m$ kg-m |
|---|---|---|---|
| | 2.4 | 0 | 0 |
| | 4.5 | 0.75 | 3.375 |
| | 3.39 | 1.8 | 6.102 |
| | −0.377 | 1.8 | −.6785 |
| | 9.91 | | 8.8 |

$$\bar{y} = \frac{\Sigma \tilde{y}m}{\Sigma m} = \frac{8.8}{9.91} = 0.888\,m$$

| SHAPE | $I_G$ | $md^2$ | $I_G + md^2$ |
|---|---|---|---|
| | $\frac{1}{12}ml^2$ $\frac{1}{12}(2.4)(.8)^2 = 0.128$ | $2.4(.888)^2 = 1.89$ | 2.02 |
| | $\frac{1}{12}(4.5)(1.5)^2 = 0.844$ | $4.5(.888-.75)^2 = 0.087$ | 0.931 |
| | $\frac{1}{2}mr^2$ $\frac{1}{2}(3.39)(.3^2) = 0.153$ | $3.39(1.8-.888)^2 = 2.82$ | 2.973 |
| | $-\frac{1}{2}(.377)(.1)^2 = .0019$ | $-.377(1.8-.888)^2 = 0.3136$ | −0.315 |
| | | | 5.61 kg-m$^2$ = $I_G$ |