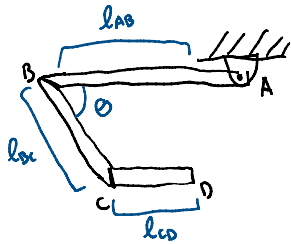20-R-KIN –DK-21     Intermediate     Rotation (RBK)

Inspiration: Hibbeler 17-60



Three slender rods with equal mass are welded together. If the assembly is released from rest, what are the reaction forces at A and the angular acceleration of the rods? The rods have a mass of **m = 2 kg** each.

Rod AB has a length **l_AB = 1.5 m**, rod BC has a length **l_BC = 1 m**, and rod CD has a length **l_CD = 0.5 m**. Initially, Rod AB and rod CD are perfectly horizontal. Rod BC forms an angle of **theta = 45 degrees** with rod AB.

Two ways to solve → Find CoG of assembly then use $I_G$
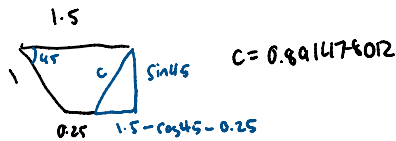Chose to find $I_A$ because I thought it was simpler

$$\sum M_P = I_P \alpha \qquad \sum M_A = I_A \alpha$$
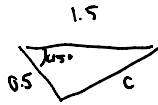
$$c^2 = 0.5^2 + 1.5^2 - 2(0.5)(1.5)\cos 45$$

$$c = 1.19972 4897$$

$$c = 0.891147 8012$$

$$I_A = \frac{1}{12}(2)(1.5^2) + (2)(0.75)^2 + \frac{1}{12}(2)(1^2) + (2)(1.19972)^2 + \frac{1}{12}(2)(0.5)^2 + (2)(0.891147 8012)^2$$

AB                              BC                              CD

$$= 11.2754 0632$$

$$\sum M_A = F_{G AB}(0.75) + F_{G BC}(1.5 - 0.5\cos 45) + F_{G CD}(1.5 - 0.5\cos 45 - 0.25)$$

$$= 2(9.81)(0.75) + 2(9.81)(1.5 - 0.5\cos 45) + 2(9.81)(1.5 - 0.5\cos 45 - 0.25) = 11.2754 0632 \alpha$$

$$\boxed{\alpha = 4.8596 58227 \text{ rad/s}^2}$$