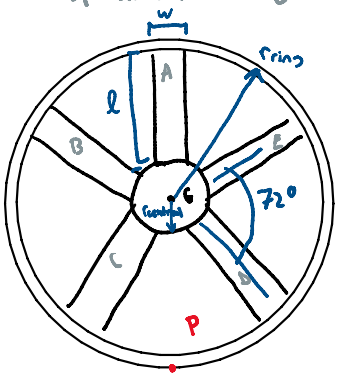
20-R-KIN-DK-10

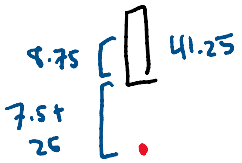
Intermediate Composite Bodies

Inspiration: None



A student on UBC Formula creates a prototype wheel cover, consisting of a thin ring, five rectangular plates, and a central circular plate. Each plate has a mass of ***m_plate = 0.5 kg*** while the ring has a mass of ***m_ring = 1 kg***. What is the mass moment of inertia if the wheel cover rotates about point P? Assume the thickness of the ring is negligible.
The ring has a radius ***r_ring = 25 cm*** while the central plate has a radius **r_central = 7.5 cm**. Each plate has a length ***l = 17.5 cm*** and width ***w = 6 cm.*** Each plate is spaced 72 degrees apart from one another.

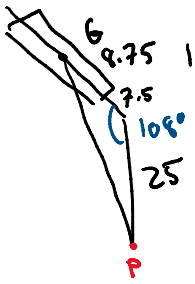
Ring: $I_P = mr^2 + md^2$
$= 1(0.25)^2 + 1(0.25)^2$
$= 0.125$



Circular Plate: $I_{P_D} = \frac{1}{2}mr^2 + md^2 = \frac{1}{2}(0.5)(0.075)^2 + 0.5(0.25)^2$
$= \frac{209}{6400}$

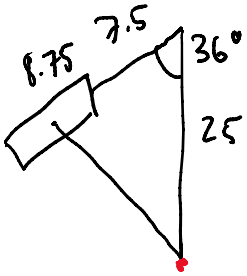
Plate A: $I_{P_A} = \frac{1}{12}m(a^2+b^2) + md^2 = \frac{1}{12}(0.5)(0.175^2+0.06^2) + 0.5(0.4125)^2$
$= 0.086504166$

Plate B, E:



$c^2 = a^2 + b^2 - 2ab\cos C$
$c^2 = 16.25^2 + 25^2 - 2(16.25)(25)\cos 108$
$c = 33.76594154$
$I_{P_B} = \frac{1}{12}(0.5)(0.175^2+0.06^2) + 0.5(0.33765941 54)^2$
$= 0.05943529 82$

Plate C, D:



$c^2 = 16.25^2 + 25^2 - 2(16.25)(25)\cos 36$
$c = 15.22284383$
$I_{P_C} = \frac{1}{12}(0.5)(0.175^2+0.06^2) + 0.5(0.15228438)^2$
$= 0.013012951$

$I = I_{P_D} + I_{P_A} + 2I_{P_B} + 2I_{P_C} = \boxed{0.26205208 2}$