

In[1]:= (* inertia tensor of a cylindrical T *)

$$r = \{x, y, z\} - \left\{0, \frac{2R + \frac{H}{2}}{17}, 0\right\};$$

MatrixForm[tensor = Dot[r, r] {{1, 0, 0}, {0, 1, 0}, {0, 0, 1}} - Outer[Times, r, r]]

Out[1]//MatrixForm=

$$\begin{pmatrix} \left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right)^2 + z^2 & -x \left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right) & -xz \\ -x \left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right) & x^2 + z^2 & -\left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right) z \\ -xz & -\left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right) z & x^2 + \left(\frac{1}{17} \left(-\frac{H}{2} - 2R\right) + y\right)^2 \end{pmatrix}$$

In[2]:= MatrixForm[ten = FullSimplify[Integrate[ρ * tensor /. x -> ρ Cos[θ] /. z -> ρ Sin[θ],
{ρ, 0, R}, {θ, 0, 2 π}, {y, 2 R, 2 R + H}] / (π R² H) + Integrate[
ρ * tensor /. x -> ρ Cos[θ] /. y -> ρ Sin[θ], {ρ, 0, 2 R}, {θ, 0, 2 π}, {z, -2 H, 2 H}] /
(16 π R² H)]]

Out[2]//MatrixForm=

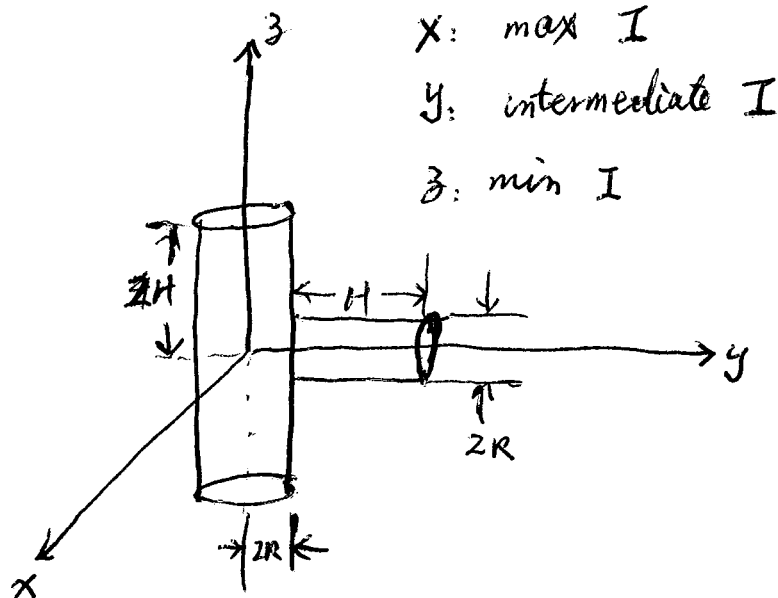
$$\begin{pmatrix} \frac{5684 H^2 + 6168 H R + 16671 R^2}{3468} & 0 & 0 \\ 0 & \frac{4 H^2}{3} + \frac{3 R^2}{2} & 0 \\ 0 & 0 & \frac{1060 H^2 + 6168 H R + 20139 R^2}{3468} \end{pmatrix}$$

In[3]:= MatrixForm[N[ten /. H -> 4 R]]

Out[3]//MatrixForm=

$$\begin{pmatrix} 38.145 R^2 & 0 & 0 \\ 0 & 22.8333 R^2 & 0 \\ 0 & 0 & 17.8117 R^2 \end{pmatrix}$$

$$CM: y = \frac{1}{16+1} \left(2R + \frac{H}{2}\right)$$



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In[8] = (* bi-stable state of rotation around the intermediate axis *)
A1 = 1.; A2 =  $\sqrt{2}$ ; A3 =  $\pi$ ; tmax = 60.;
sol = NDSolve[{A1  $\omega_1'$ [t] == (A2 - A3)  $\omega_2$ [t]  $\omega_3$ [t],
  A2  $\omega_2'$ [t] == (A3 - A1)  $\omega_3$ [t]  $\omega_1$ [t], A3  $\omega_3'$ [t] == (A1 - A2)  $\omega_1$ [t]  $\omega_2$ [t],
   $\omega_1$ [0] == 0.01,  $\omega_2$ [0] == 1,  $\omega_3$ [0] == 0}, { $\omega_1$ [t],  $\omega_2$ [t],  $\omega_3$ [t]}, {t, 0, tmax}];

In[8] = Plot[ $\omega_1$ [t] /. sol, {t, 0, tmax}]
Plot[ $\omega_2$ [t] /. sol, {t, 0, tmax}]
Plot[ $\omega_3$ [t] /. sol, {t, 0, tmax}]

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