

```
In[2228]:= ClearAll["Global`*"]
```

```
(* http://mini.pw.edu.pl/~porter/cc/psw/psw_cw2.pdf *)
```

```
(* System: Two bars and a cone *)
```

```
(* ----- Global Variables ----- *)
```

```
$Density := 1;
```

```
(* ----- Functions ----- *)
```

```
$I[$Integral_, a_, b_, c_, x_, y_, z_] := {  
  {$Integral[a, b, c, y^2 + z^2],  
   -$Integral[a, b, c, x * y],  
   -$Integral[a, b, c, x * z]},  
  {$Integral[a, b, c, x * y],  
   $Integral[a, b, c, x^2 + z^2],  
   -$Integral[a, b, c, y * z]},  
  {$Integral[a, b, c, x * z],  
   -$Integral[a, b, c, y * z],  
   $Integral[a, b, c, y^2 + x^2]}};
```

```
$IPointFun[x_, y_, z_, m_] :=  
  m * {  
    {y^2 + z^2, -x * y, -x * z},  
    {-x * y, x^2 + z^2, -y * z},  
    {-x * z, -y * z, x^2 + y^2}};
```

```
$PlotInertiaTensor[I_, a_] := Show[ContourPlot3D[  
  {{ix, iy, iz}.I.{ix, iy, iz} == 1}, {ix, -a, a}, {iy, -a, a}, {iz, -a, a}]]
```

```
(* ----- *)
```

```
$Integral[a_, b_, c_, f_] := $Density *  $\int_0^a \int_0^b \int_0^c f \, dz \, dy \, dx$ ;
```

```
$Mass = $Integral[a, b, c, 1];
```

```
$CenterOfMass := {  
  $Integral[a, b, c, x],  
  $Integral[a, b, c, y],  
  $Integral[a, b, c, z]} / $Mass;
```

```
$IAll = $I[$Integral, a, b, c, x, y, z];
```

```
$f = {0, -$Mass * g, 0};
```

```
$N = Cross[$CenterOfMass, $f];
```

```
W = {Wx, Wy, Wz};
Wt = {Wtx, Wty, Wtz};
```

```
(* Prints *)
Print["Mass:"]
N[$Mass]
Print["Center Of Mass:"]
MatrixForm[N[$CenterOfMass]]
Print["Inertia Tensor:"]
MatrixForm[N[$IAll]]
```

```
Print["Gravity"]
MatrixForm[N[$f]]
Print["Torque (body)"]
MatrixForm[N[$N]]
```

```
Print["Euler Equation"]
StringForm["` `` ` = ` ` + Cross[` `` ` , ` `]",
  MatrixForm[N[$IAll]], MatrixForm[Wt], MatrixForm[N[$N]],
  MatrixForm[N[$IAll]], MatrixForm[W], MatrixForm[W]]
StringForm["Qt=Q ` ` / 2", W]
```

Mass:

Out[2242]= $a b c$

Center Of Mass:

Out[2244]//MatrixForm=

$$\begin{pmatrix} 0.5 a \\ 0.5 b \\ 0.5 c \end{pmatrix}$$

Inertia Tensor:

Out[2246]//MatrixForm=

$$\begin{pmatrix} 0.333333 a b c (b^2 + c^2) & -0.25 a^2 b^2 c & -0.25 a^2 b c^2 \\ -0.25 a^2 b^2 c & 0.333333 a b c (a^2 + c^2) & -0.25 a b^2 c^2 \\ -0.25 a^2 b c^2 & -0.25 a b^2 c^2 & 0.333333 a b (a^2 + b^2) c \end{pmatrix}$$

Gravity

Out[2248]//MatrixForm=

$$\begin{pmatrix} 0. \\ -1. a b c g \\ 0. \end{pmatrix}$$

Torque (body)

Out[2250]//MatrixForm=

$$\begin{pmatrix} 0.5 a b c^2 g \\ 0. \\ -0.5 a^2 b c g \end{pmatrix}$$

Euler Equation

$$\text{Out}[2252]= \begin{pmatrix} 0.333333 a b c (b^2 + c^2) & -0.25 a^2 b^2 c & -0.25 a^2 b c^2 \\ -0.25 a^2 b^2 c & 0.333333 a b c (a^2 + c^2) & -0.25 a b^2 c^2 \\ -0.25 a^2 b c^2 & -0.25 a b^2 c^2 & 0.333333 a b (a^2 + b^2) c \end{pmatrix} \begin{pmatrix} Wtx \\ Wty \\ Wtz \end{pmatrix} = \begin{pmatrix} 0.5 a b c^2 g \\ 0. \\ -0.5 a^2 b c g \end{pmatrix}$$

$$\text{Out}[2253]= Qt=Q \{Wx, Wy, Wz\} / 2$$