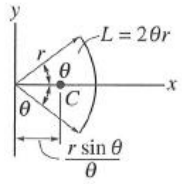
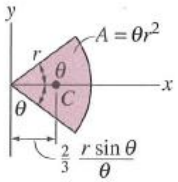
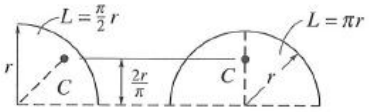
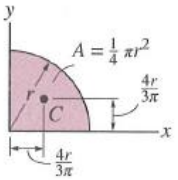
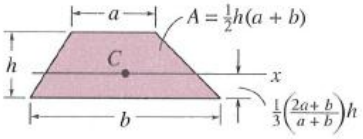
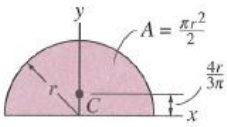
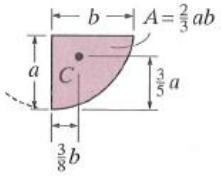
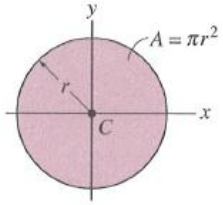
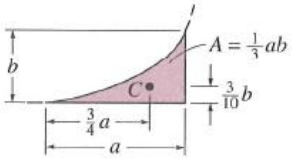
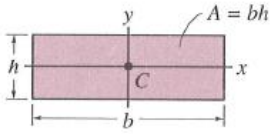
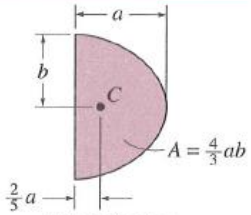
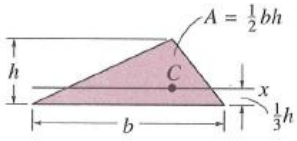
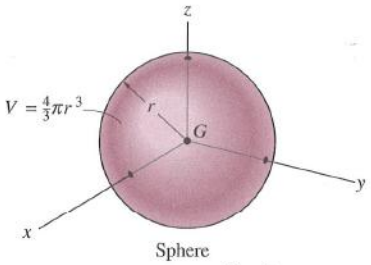
Geometric Properties of Line and Area Elements

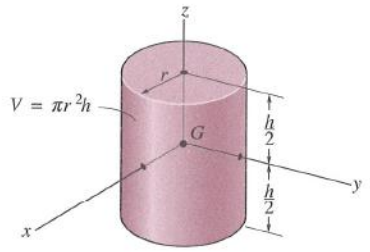
Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2)\theta$ $I_x = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2)\theta$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16}\pi r^4$ $I_y = \frac{1}{16}\pi r^4$
 Trapezoidal area	 Semicircular area	$I_x = \frac{1}{8}\pi r^4$ $I_y = \frac{1}{8}\pi r^4$
 Semiparabolic area	 Circular area	$I_x = \frac{1}{4}\pi r^4$ $I_y = \frac{1}{4}\pi r^4$
 Exparabolic area	 Rectangular area	$I_x = \frac{1}{12}bh^3$ $I_y = \frac{1}{12}hb^3$
 Parabolic area	 Triangular area	$I_x = \frac{1}{36}bh^3$

Center of Gravity and Mass Moment of Inertia of Homogeneous Solids



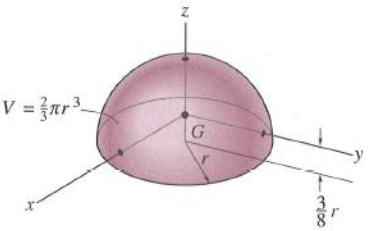
Sphere

$I_{xx} = I_{yy} = I_{zz} = \frac{2}{5} mr^2$



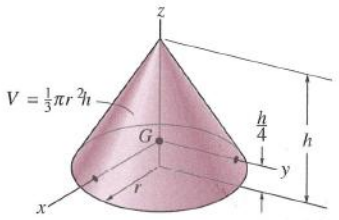
Cylinder

$I_{xx} = I_{yy} = \frac{1}{12} m(3r^2 + h^2)$ $I_{zz} = \frac{1}{2} mr^2$



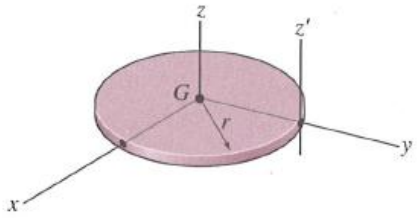
Hemisphere

$I_{xx} = I_{yy} = 0.259mr^2$ $I_{zz} = \frac{2}{5} mr^2$



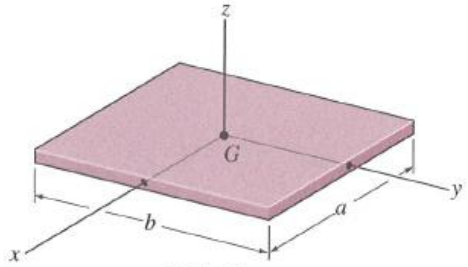
Cone

$I_{xx} = I_{yy} = \frac{3}{80} m(4r^2 + h^2)$ $I_{zz} = \frac{3}{10} mr^2$



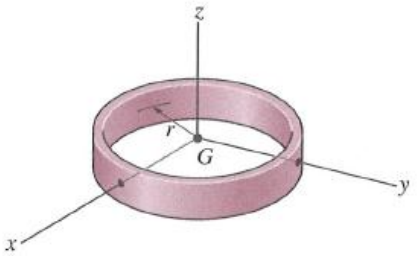
Thin Circular disk

$I_{xx} = I_{yy} = \frac{1}{4} mr^2$ $I_{zz} = \frac{1}{2} mr^2$ $I_{z'z'} = \frac{3}{2} mr^2$



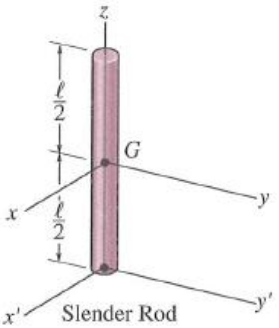
Thin plate

$I_{xx} = \frac{1}{12} mb^2$ $I_{yy} = \frac{1}{12} ma^2$ $I_{zz} = \frac{1}{12} m(a^2 + b^2)$



Thin ring

$I_{xx} = I_{yy} = \frac{1}{2} mr^2$ $I_{zz} = mr^2$



Slender Rod

$I_{xx} - I_{yy} = \frac{1}{12} m\ell^2$ $I_{x'x'} = I_{y'y'} = \frac{1}{3} m\ell^2$ $I_{z'z'} = 0$

APPENDIX A
TABLE OF INTEGRALS

$$\int \sin x dx = -\cos x$$

$$\int \cos x dx = \sin x$$

$$\int e^x \, dx = e^x$$

$$\int x^n dx = \frac{1}{n+1} x^{n+1}$$

$$\int \frac{1}{x} \, dx = \ln|x|$$

$$\int \sqrt{(a+bx)} \, dx = \frac{2(a+bx)^{3/2}}{3b}$$

$$\int x\sqrt{(a+bx)} \, dx = \frac{2\sqrt{(a+bx)}\left(-2a^2+bxa+3b^2x^2\right)}{15b^2}$$

$$\int \sqrt{(a^2+b^2x^2)} \, dx = \frac{\log\left(b\left(bx+\sqrt{a^2+b^2x^2}\right)\right)a^2+bx\sqrt{(a^2+b^2x^2)}}{2b}$$

$$\int x\sqrt{(a^2+b^2x^2)} \, dx = \frac{(a^2+b^2x^2)^{3/2}}{3b^2}$$

$$\int x^2\sqrt{(a^2+b^2x^2)} \, dx = \frac{bx\sqrt{(a^2+b^2x^2)}\left(a^2+2b^2x^2\right)-a^4\log\left(b\left(bx+\sqrt{(a^2+b^2x^2)}\right)\right)}{8b^3}$$

$$\int \sqrt{(a^2-b^2x^2)} \, dx = \frac{\tan^{-1}\left(\frac{bx}{\sqrt{a^2-b^2x^2}}+\right)a^2}{2b}+\frac{1}{2}x\sqrt{(a^2-b^2x^2)}$$

$$\int x\sqrt{(a^2-b^2x^2)} \, dx = -\frac{(a^2-b^2x^2)^{3/2}}{3b^2}$$

$$\int x^2\sqrt{(a^2-b^2x^2)} \, dx = \frac{\tan^{-1}\left(\frac{bx}{\sqrt{a^2-b^2x^2}}\right)a^4}{8b^3}+\sqrt{(a^2-b^2x^2)}\left(\frac{x^3}{4}-\frac{a^2x}{8b^2}\right)$$