**Mass Moment of Inertia Quiz**

value units answer

mass m \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

length L \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

width w \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

thickness t \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

density  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

mass moment J \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 slug = 32.174 lbm

**Mass Moment of Inertia Review**

T



m

r

F

a

m

T = F r F = m a a = r 

F = m r  T = m r2  J J = m r2



b/4

b/4

m/2

m/2

b

m



b/8

b/8

m/4

m/4

m/4

m/4

3b/8

3b/8



m/6

m/6

m/6

m/6

m/6

m/6

b/12

3b/12

b/12

3b/12

5b/12

5b/12





h

x

y

r

b

m













h

x

y

z

t

b

h

y

x

z

t

b





x

y

z

t

R









**Radius of Gyration**

Radius of gyration k is defined as an equivalent radius at which the entire mass of an object would be concentrated if it were a thin ring. It is a simple way to express mass moment that helps visualize an equivalent size.



As an example, for a long thin rod 

As an example, for a circular disk 

**Mass Moment of Inertia for Disk with Slots**

The disk shown below has two rectangular slots. The disk is 2.5 cm thick and the slots go completely through the disk. The density is 7.8 g/cm3.

Determine the mass, centroidal mass moment of inertia and the radius of gyration of the disk with slots.

3.534 cm

1.298 kg

16.21 kg.cm2

m \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ JG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**G**

**d**

rC = 5 cm

mC =  r2 t  = 1.532 kg

JC = mC rC2 / 2 = 19.144 kg.cm2

bS = 6 cm, hS = 1 cm, dS = 2.5 cm

mS = bS hS t  = 0.117 kg

JS = mS (bS2 + hS2) / 12 = 0.361 kg.cm2

m = mC - 2 mS = 1.298 kg

JG = JC - 2 JS - 2 mS dS2 = 16.96 kg.cm2

kG = sqrt( JG / m ) = 3.534 cm

1 cm

steel

What material was used to manufacture this disk? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Comment on the manufacturability of this design.

square corners on slots are difficult to machine