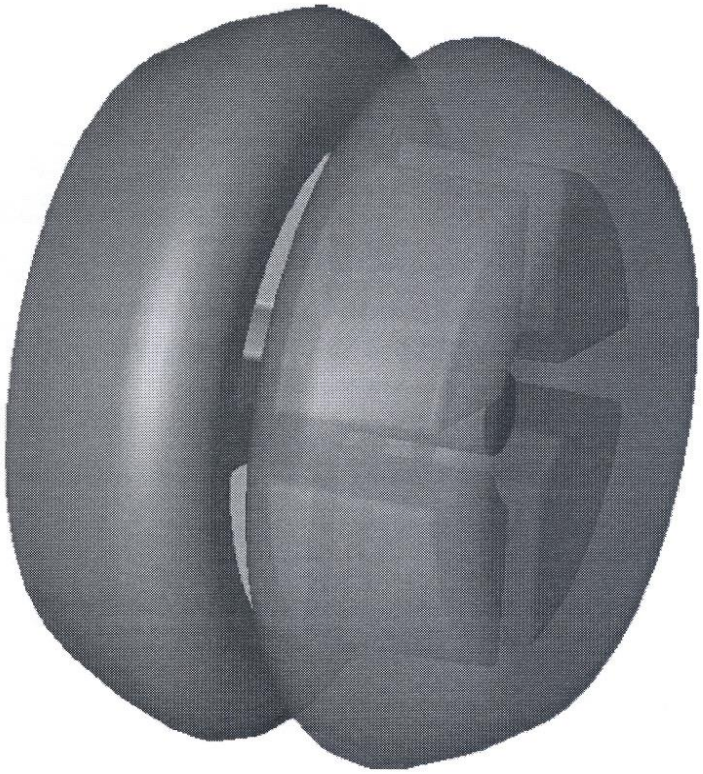
Section 22

Drawing #24

Solids: Yo-Yo

Objectives

- Create Spheres
- Create Cavities
- Working with Levels



The last section covered a little bit about molds. It primarily mentioned metal as something that can be shaped this way, but there are a wide variety of other materials that people shape with molds. Foods like some chocolates, lollipops and "gummy" candies are molded, as are many plastic, glass and ceramic objects. Many of the parts of the computer you use to create CAD drawings were molded to shape, as are the parts of the chair and desk you sit at or the car you travel in.

Before you make the mold, you will create an object with multiple parts and levels. You will also be introduced to more keyboard shortcuts.

The object you will create is a yo-yo. The yo-yo, known to have been used over three-thousand years ago, is considered to be the second oldest toy in history, after the doll. Yo-yos were used in ancient civilizations like those in Greece and China. The yo-yo made it to Europe in the 1700's, where members of the royal court called them jou-jous. In 1866, James L. Haven and Charles Hettrich became the first to patent the toy in the United States under the name whirligig, but it was Philipino-American Pedro Flores who was the first to start manufacturing and marketing yo-yos in 1928, helping to start a fad that lasted for decades.

Start to draw on
Front View

Base Point

Keep the default display view and CPlane settings.

Position to create a base point to position the yo-yo

Key In X= **0** Y= **0** Z= **0**

Create a Sphere

This sphere will form the basic body of half of the yo-yo. The two most common types of yo-yo shapes are the imperial and butterfly: you will be drawing geometry for the imperial.

Create

Primitive Solid or SHIFT P

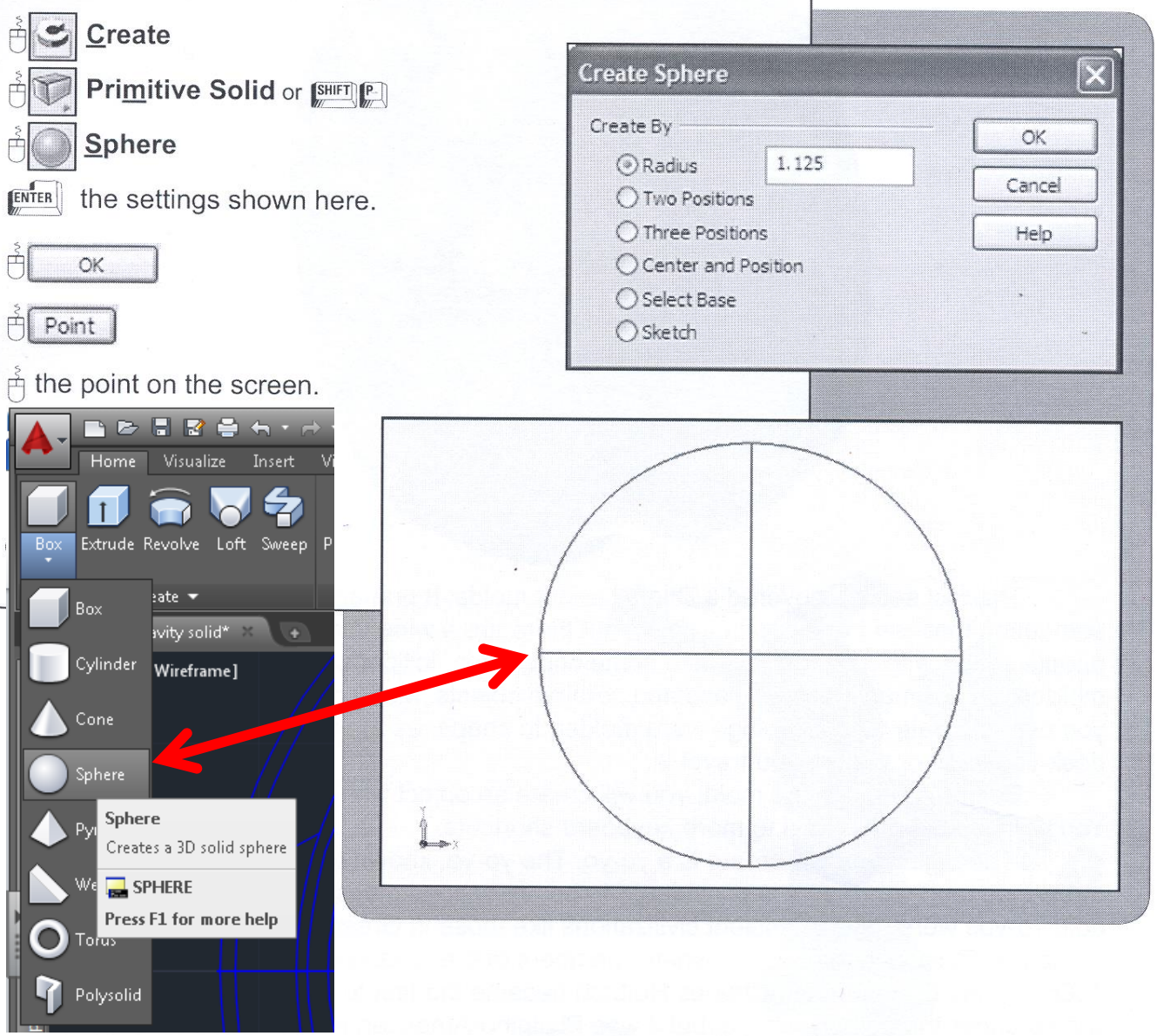
Sphere

ENTER the settings shown here.

OK

Point

the point on the screen.



Cutting Lines

Vertical

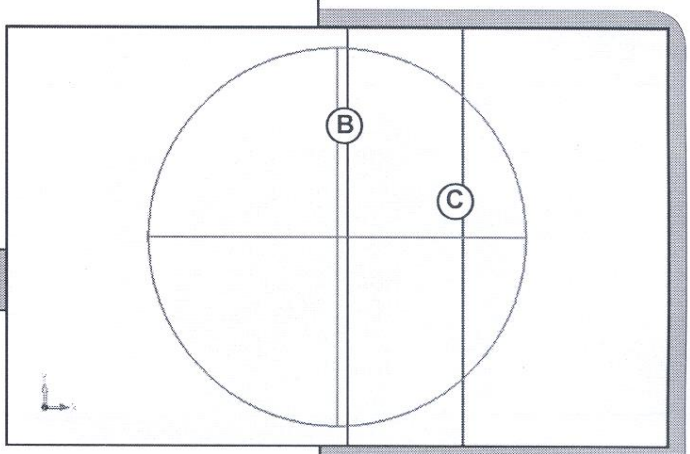
Key In

ENTER the coordinates for these two lines:

(B) X= .06 Y=0 Z=0

(C) X= .75 Y=0 Z=0

OFFSET THE ORIGIN LINE TWICE
AT 0.06 CREATES LINE B
AT 0.75 CREATES LINE C

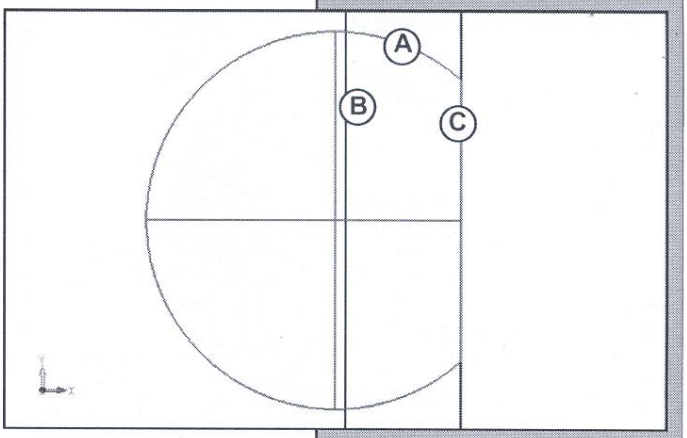


SLICE USING B LINE

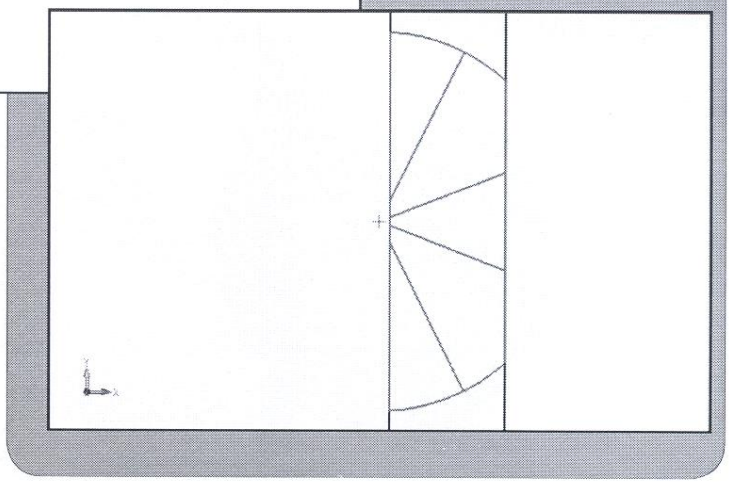
THEN

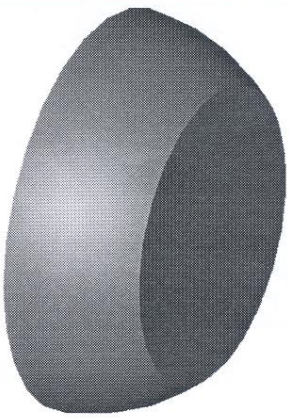
SLICE USING C LINE

Delete the two sides to get one side of the yoyo



Delete the two lines.





Set the CPlane

and rotate the view so you can see the larger circular face.

Create

Solid Feature

Hole

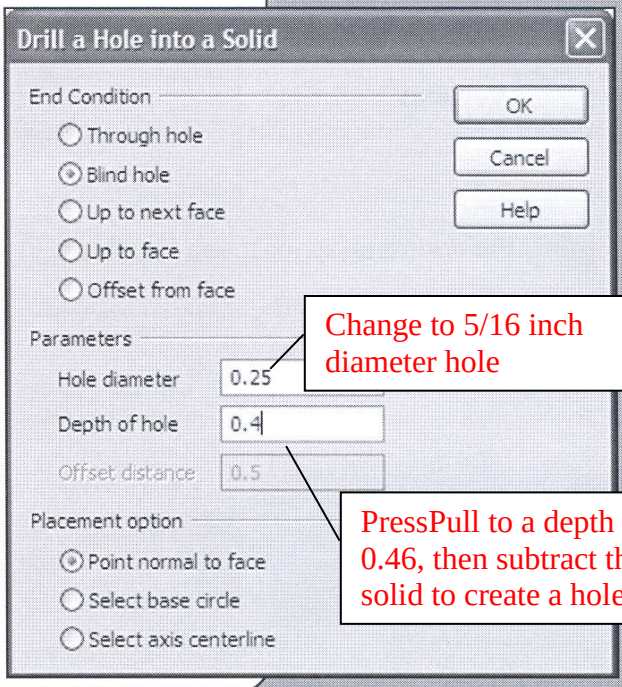
OK

the large circular face.

Ctr/Mid or use

the edge of the circular face.

This is the hole for the spindle.



Change to 5/16 inch diameter hole

PressPull to a depth of 0.46, then subtract the solid to create a hole

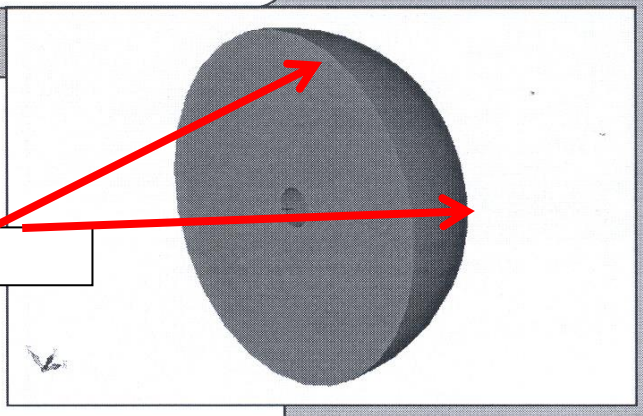
Round the Edges

Smooth out the edges of the yo-yo.

SHIFT H

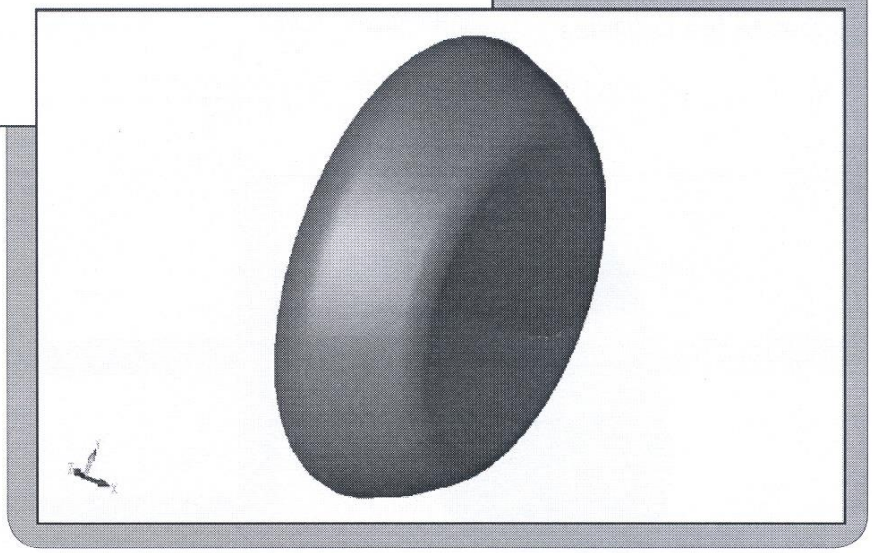
Constant Blend

Fillet Edge



ENTER **.2** for the radius.

the two circular edges.



Cavities pt. 1

To see the next steps better, Change the color to red. (or you can change to the center line layer) make the Left View Active.

CTRL 6 to change the construction plane.

C or to create a **Ø 1.5"** circle.

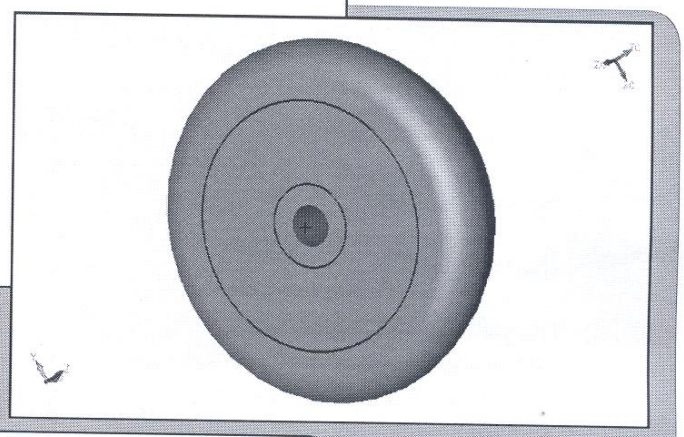
Ctr/Mid or use to position the circle.

the edge of the hole.

BackUp

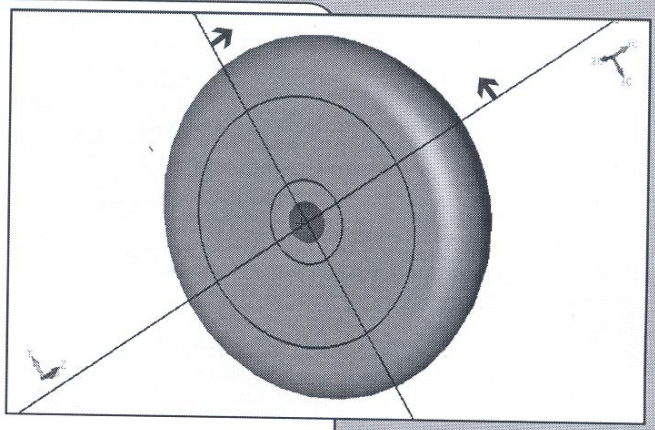
Ø .5 for the next circle.

the edge of the cylindrical face again.



Cavities pt. 2

Draw Veritcal and Horizontal Lines to cross the center of the circles, snap to the center markers.

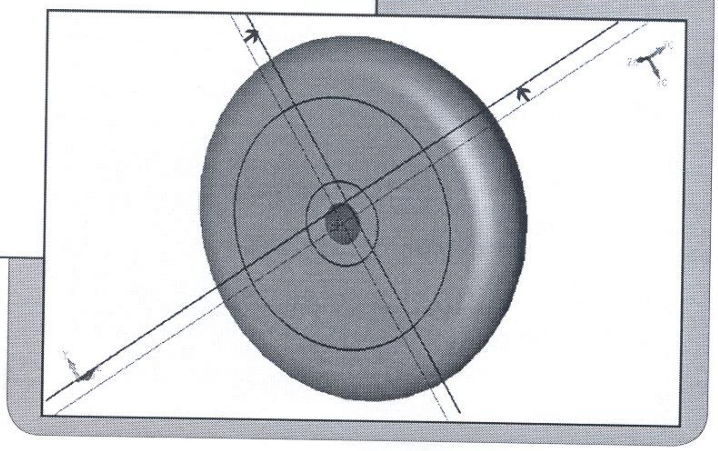


L

Parallel Distance

ENTER **.1**

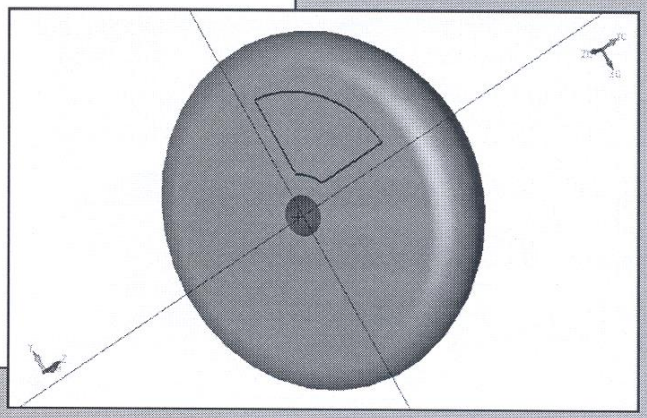
Offset the lines 0.1 in the direction of the arrows shown



Cavities pt. 3

Trim the circles and the lines to create this shape.

Delete the other center lines



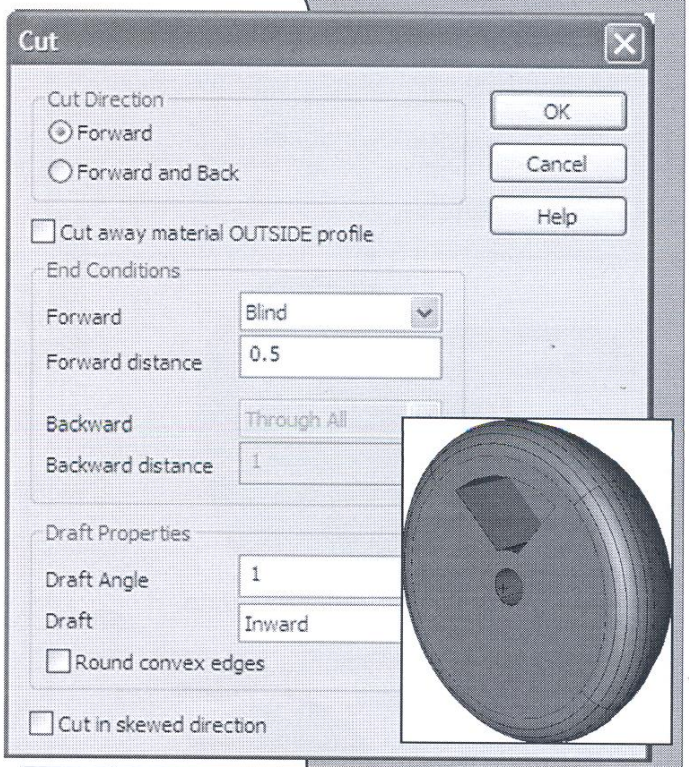
Cavities pt. 4

Copy Array to have four new objects lines

PressPull the new shape in to the yoyo body, ½ inch to make a cavity / hole in the side.

OR

Extrude to create a solid, copy array to have four pieces then Subtract to create voids



Accept.

the arrow pointing into the stock.

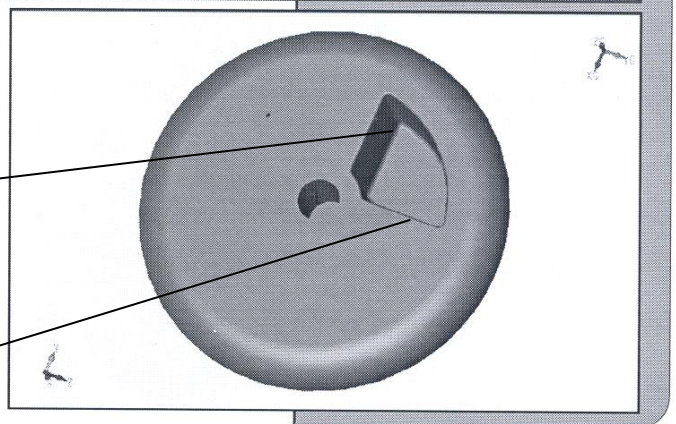
SHIFT H

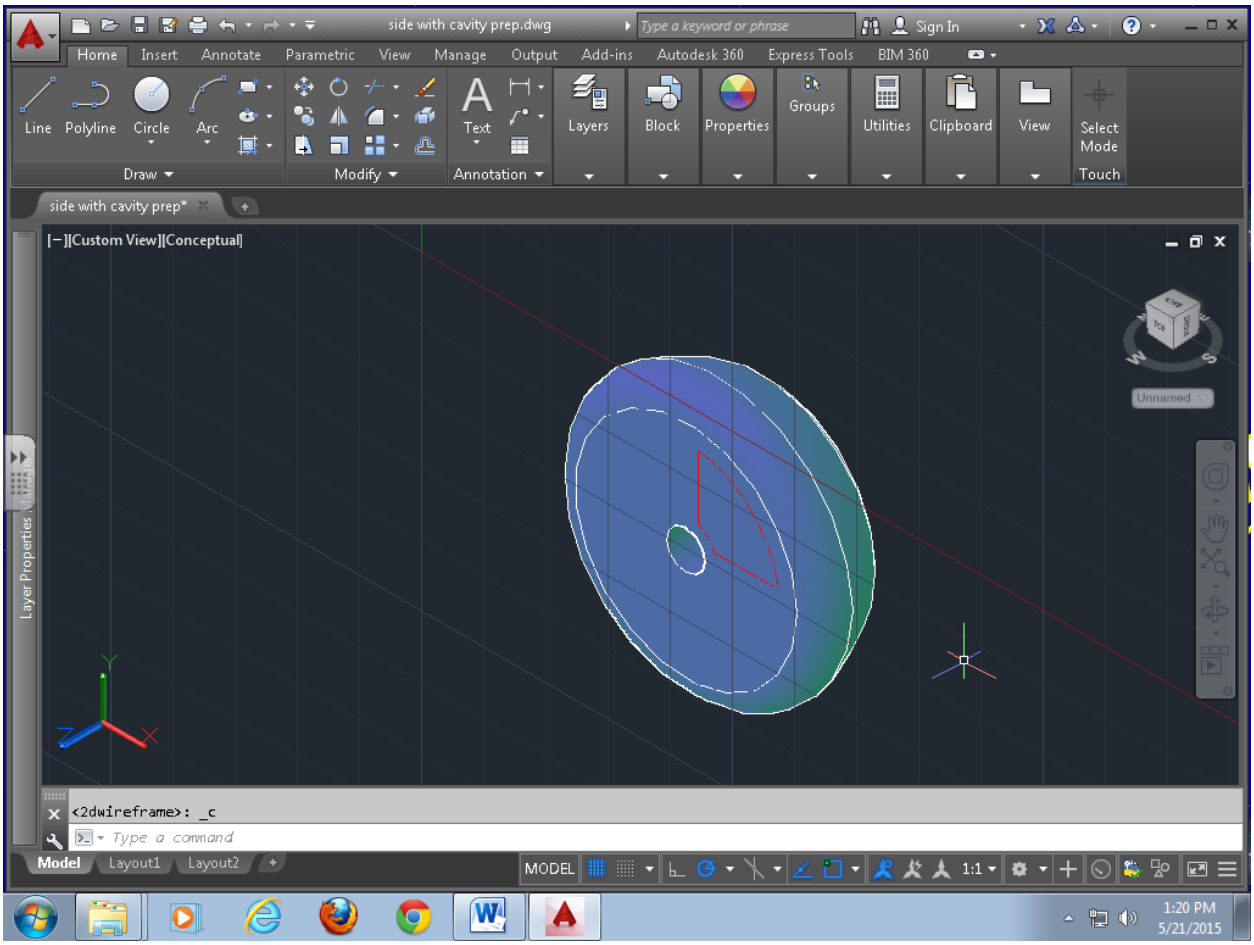
Fillet Edge for all four

Fillet the pocket edges cutting into the stock with .030 radii.

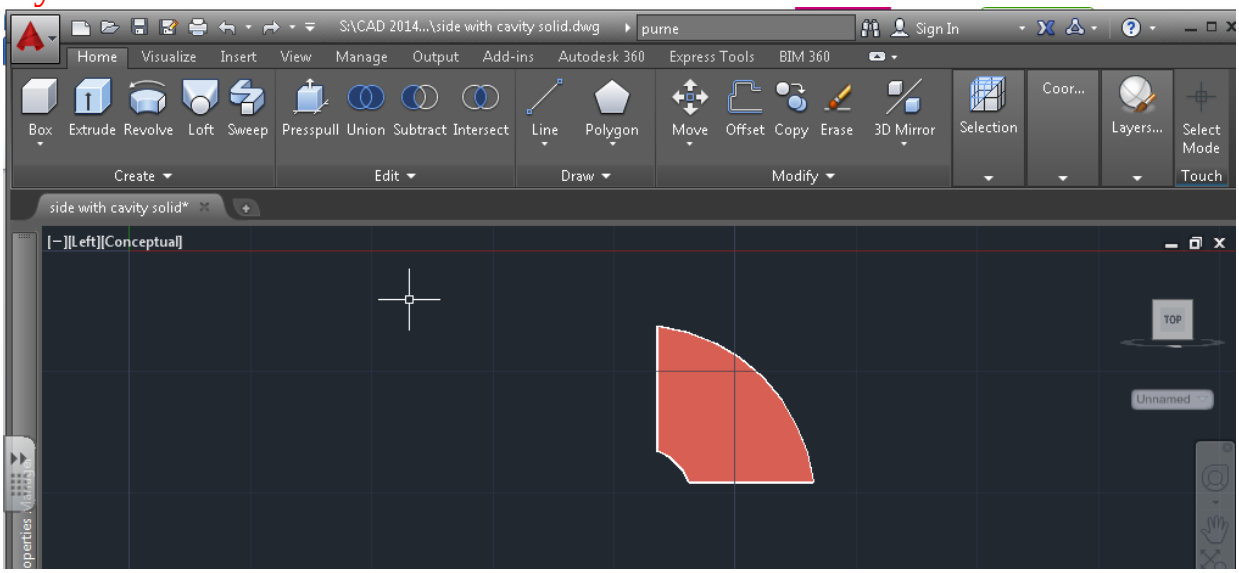
BackUp.

Fillet the top edges of the pockets with .015 radii.

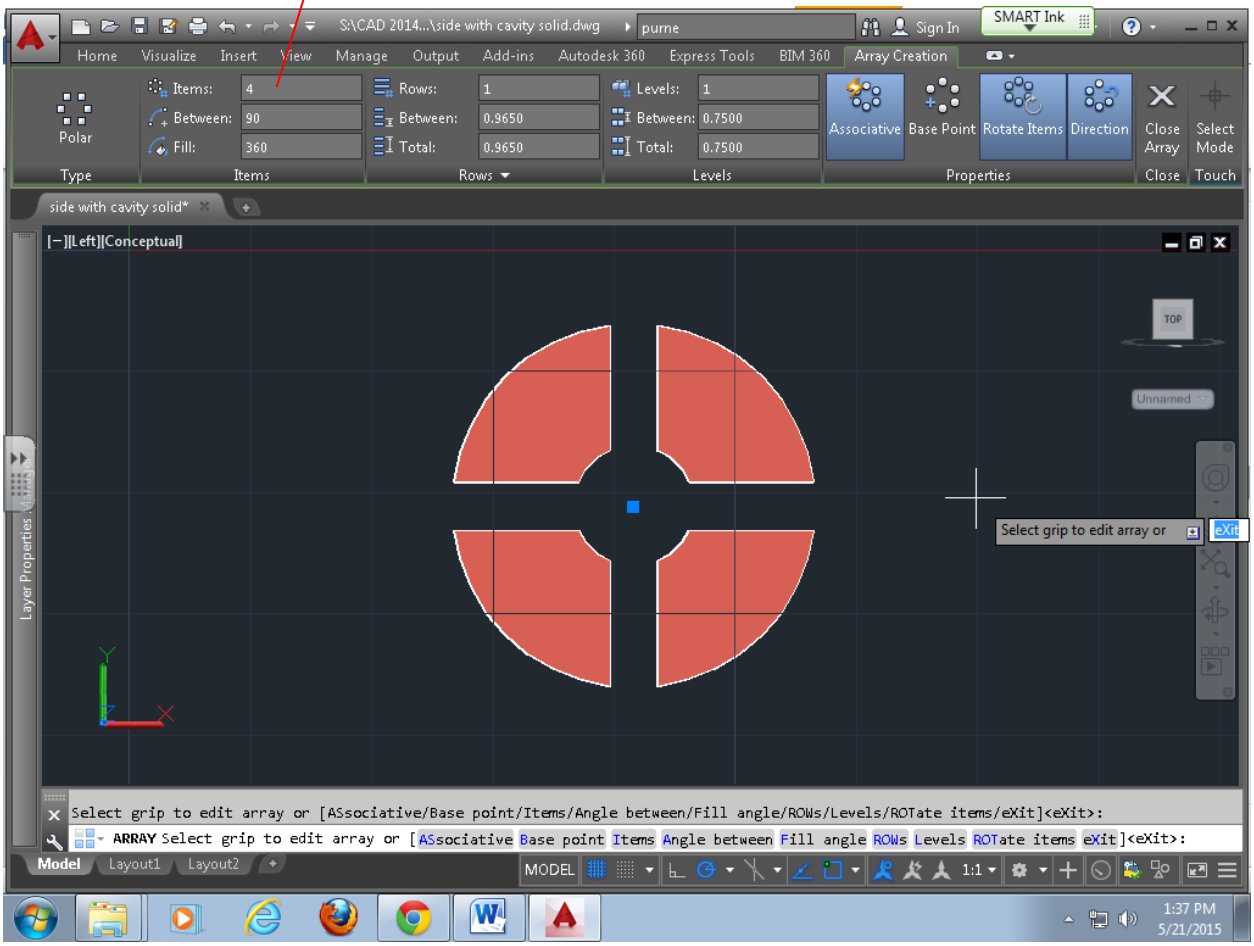




Extrude about 1 inch to create a solid, extrude larger inorder to ensure the object will intersect the yoyo face Create it in center line layer, and turn off the object line layer.

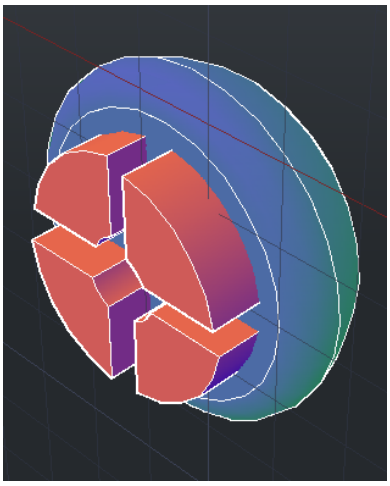


POLAR ARRAY copy to have four, 90 degree angles, and fill 360 degrees



The Arrayed objects are a set, you will have to EXPLODE THE SET ONCE TO MAKE THEM INDIVIDUAL PIECES.

Turn on the Object Line Layer and then Subtract the new objects from the yoyo side to create cavities.



Cavities pt. 5

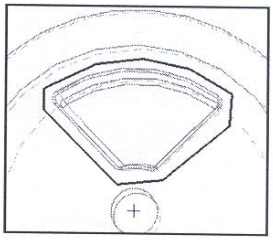
SHIFT B

Prune

Copy

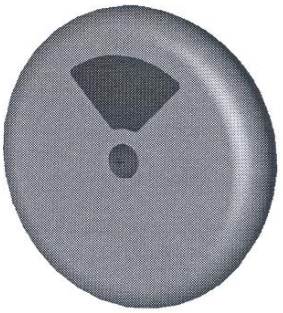
Now select ALL of the faces of the pocket.

You can try the Polygon All In *option and surround the pocket as shown here. Or you can select each face individually by spinning the viewport to get at them all.*



Accept when they are ALL highlighted.

It will look like the pocket is filled in with material that is the same color as the active color.

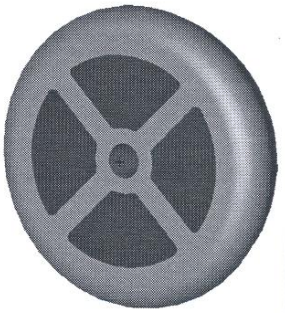


CTRL 6 to set the Left CPlane.

J

Copy

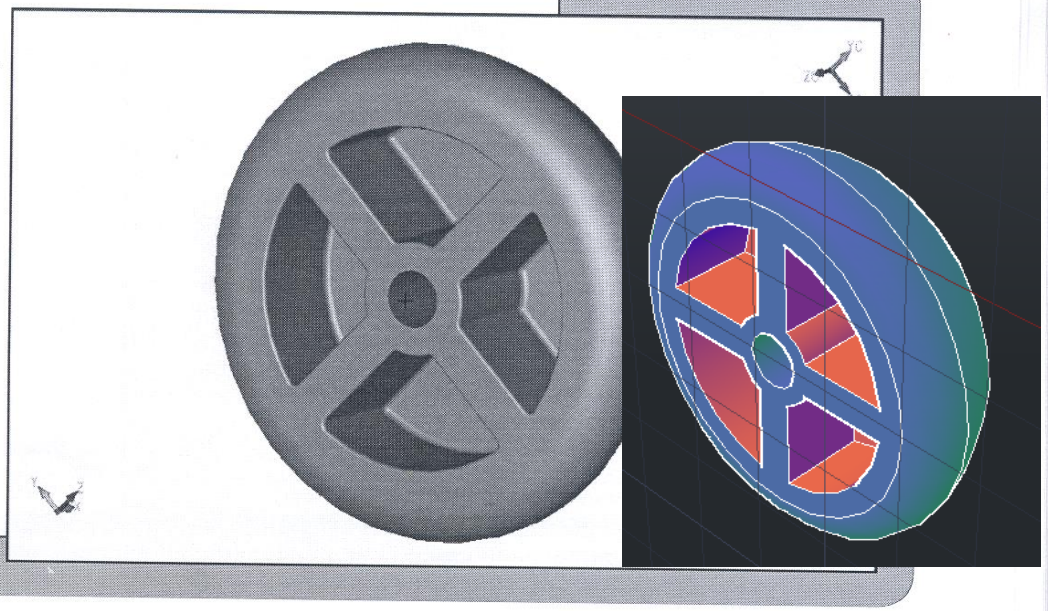
Make three copies of the pruned solid at 90°. Use the center point as the axis of the rotation.



SHIFT B

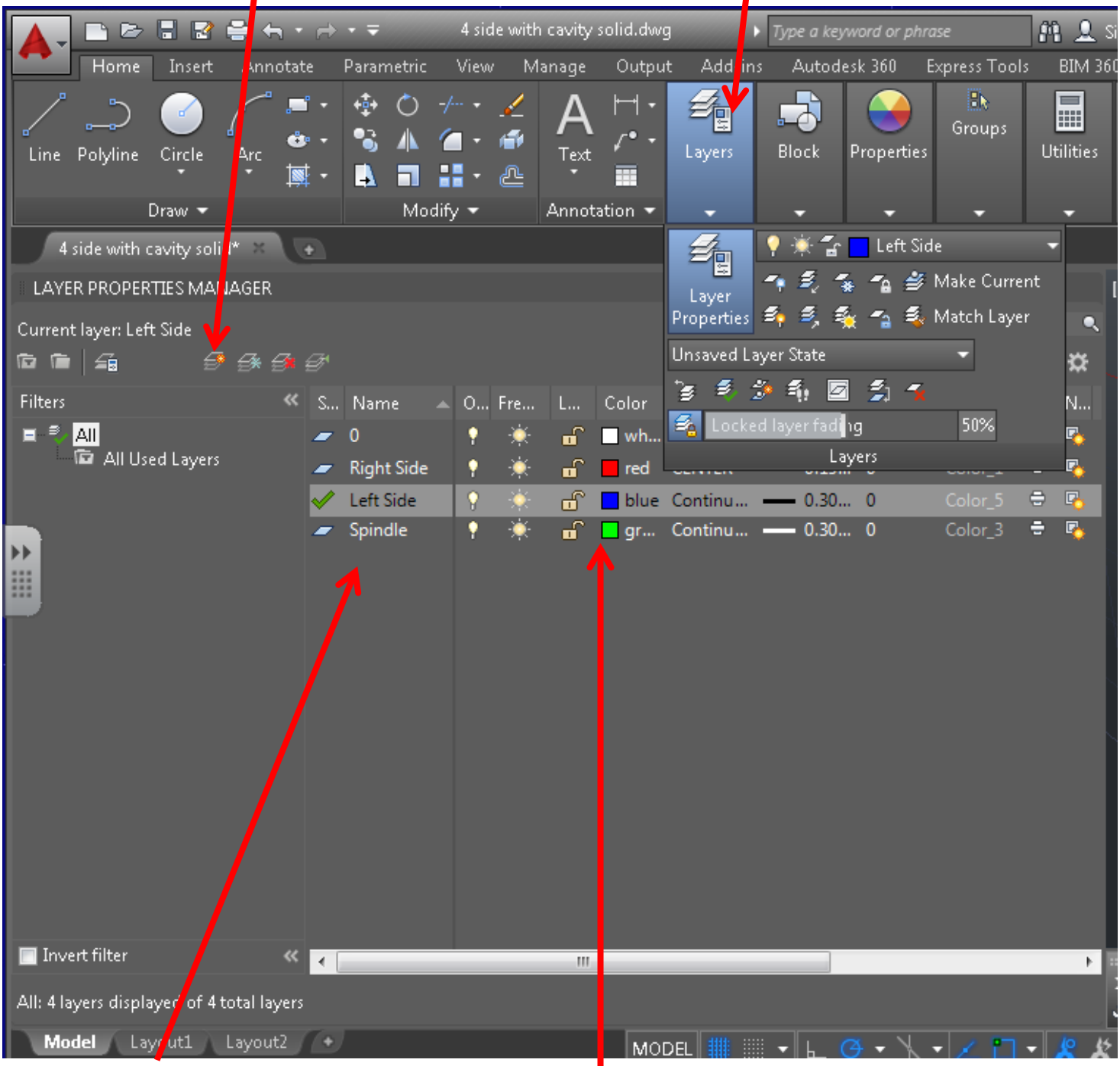
Subtract

and remove the four new solids from the body of the yo-yo.



Open up the Layer Properties Manager- Create 2 new layers.

Use this icon to create a new layer



Rename Object layer – Right Side
Rename New Layer – Left Side
Rename New Layer – Spindle

CHANGE COLORS SO YOU CAN SEE THE DIFFERENCE ON THE SCREENS

NOTE: BEFORE YOU MIRROR CREATE YOUR DESIGN SO YOU WILL MIRROR A DESIGNED VERSION

The Other Half

Now copy the half of the yo-yo you drew to make the other half.

G *to enter the X-form Mirror command.*

Copy

the half of the yo-yo on level 1.

Accept.

1 Pos V.

Point or use

the point on the screen.

CTRL A *to Autoscale the viewport*

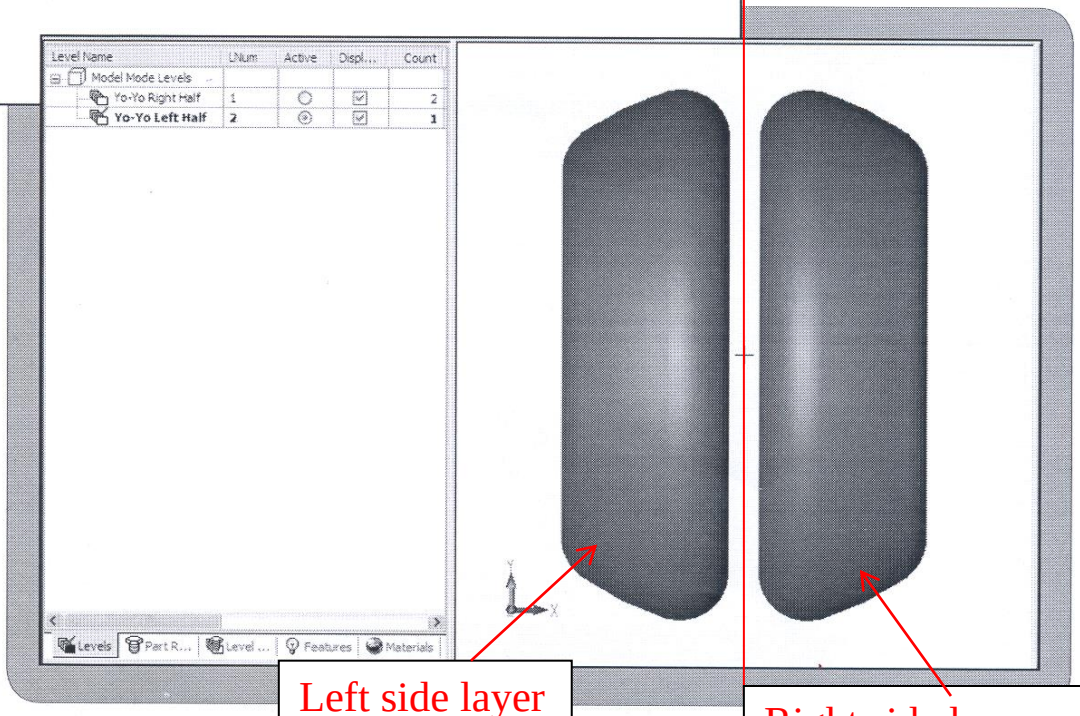
You have the two halves of your yo-yo.

Notice that the new part changed the count on level 2?

Try turning the Display for each level on and off and see what happens.

to delete the point.

MIRROR THE OTHER SIDE USING THE ORIGIN LINE AS THE MIRROR LINE
The spacing will be automatic



Left side layer

Right side layer

CREATE SPINDLE ON THE SPINDLE LAYER

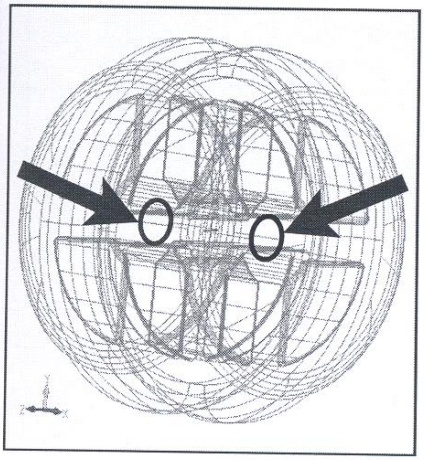
The Spindle

ALT L

Create a new level.

Rename it ***Spindle***.

Level Name	LNum	Active	Displ...	Count
Model Mode Levels				
Yo-Yo Right Half	1	○	☑	2
Yo-Yo Left Half	2	○	☑	1
Spindle	3	◉	☑	0



Render the view as a wireframe

Rotate your view so you can see the two circles marked with arrows in the picture.

SHIFT P

CREATE a Cylinder

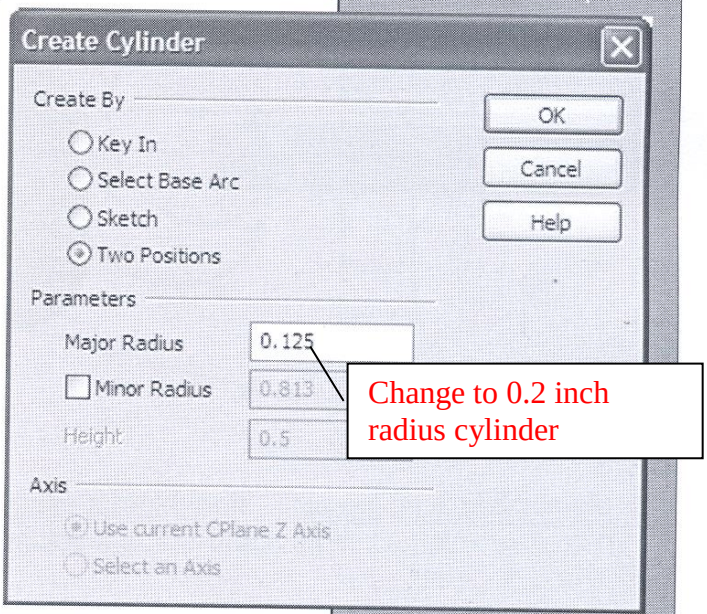
Cylinder

ENTER the settings shown here.

OK

the two circles that describe the edges of the bottom of each hole.

See the two arrows above.

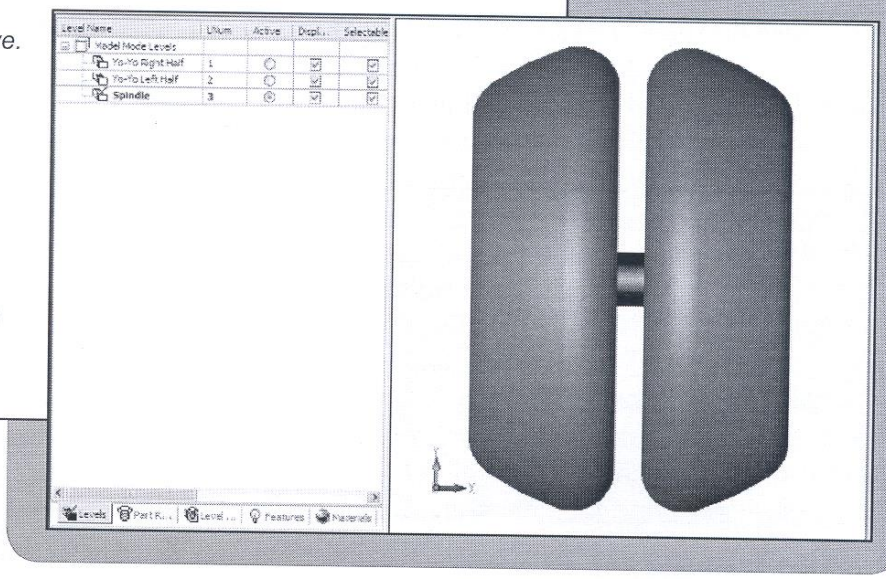


Change to 0.2 inch radius cylinder

ALT 1

and Autoscale.

Watch what happens when you turn off Levels 1 and 2 in the "Displayed" Column.



Spinning

Let's try something different

Rotate or ALT SHIFT V

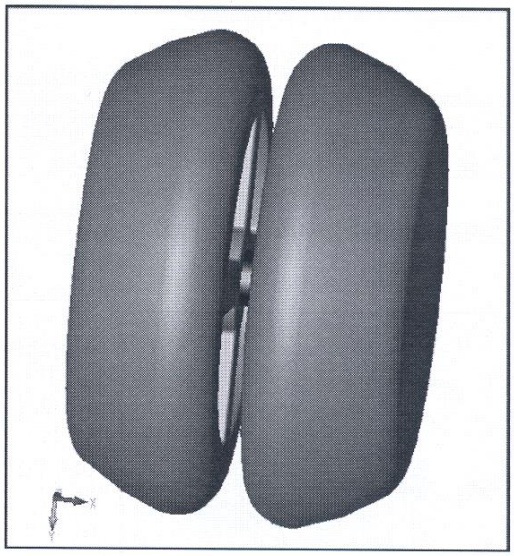
Rotate the yo-yo until you can see some of the inside.

DON'T ESCAPE YET!

X

Spin

Now slowly drag the cursor down the viewport and watch what happens.



You are to layout the yoyo according to this hand out.