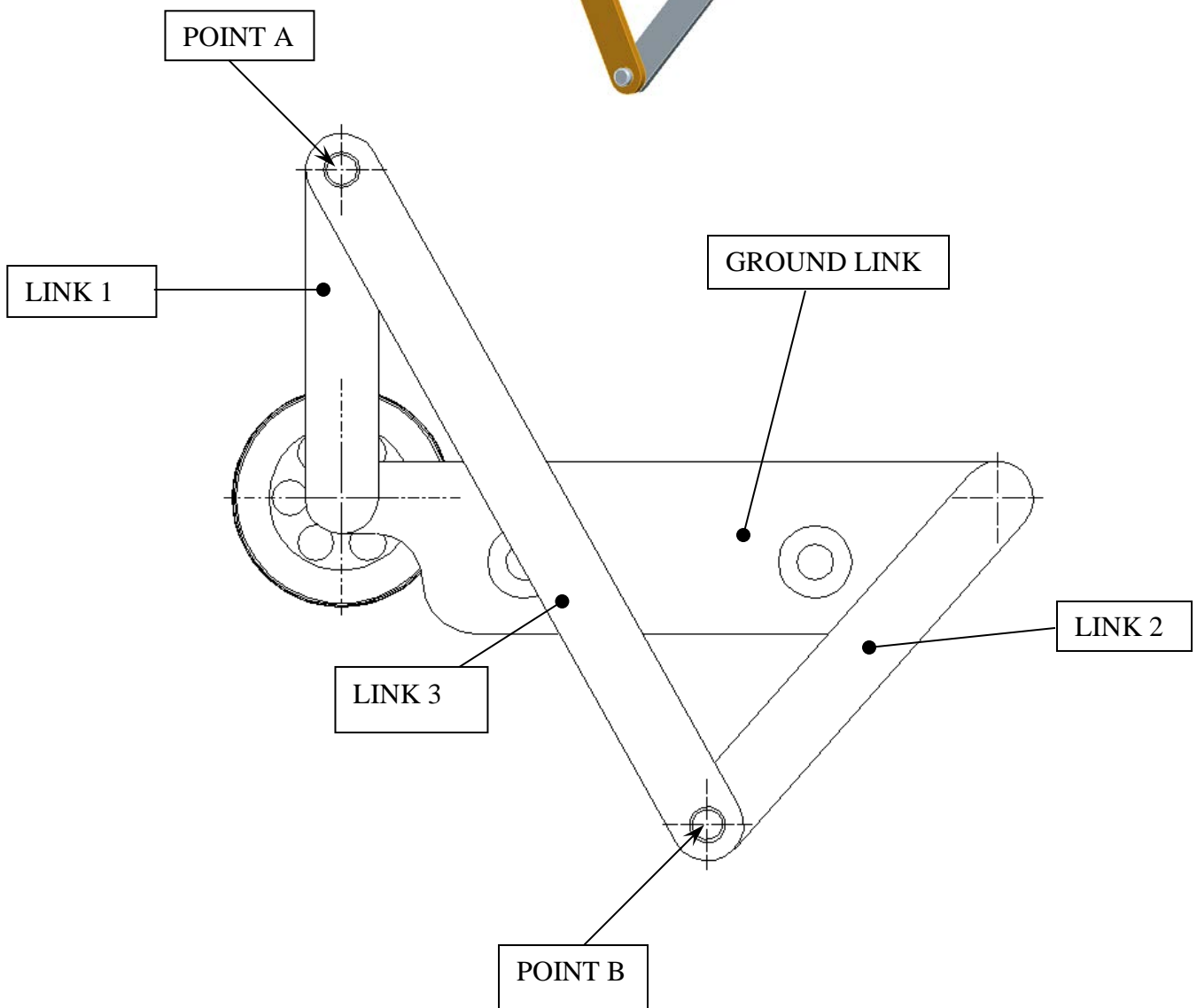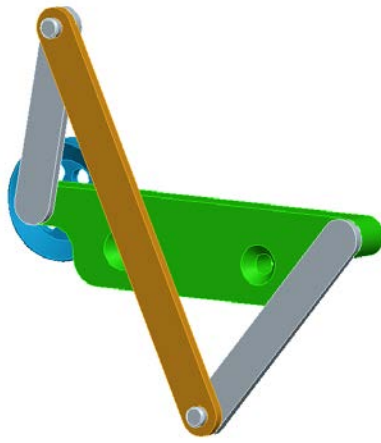Mechanism Design
Creo 2.0
Level 7

POINT A

GROUND LINK

LINK 1
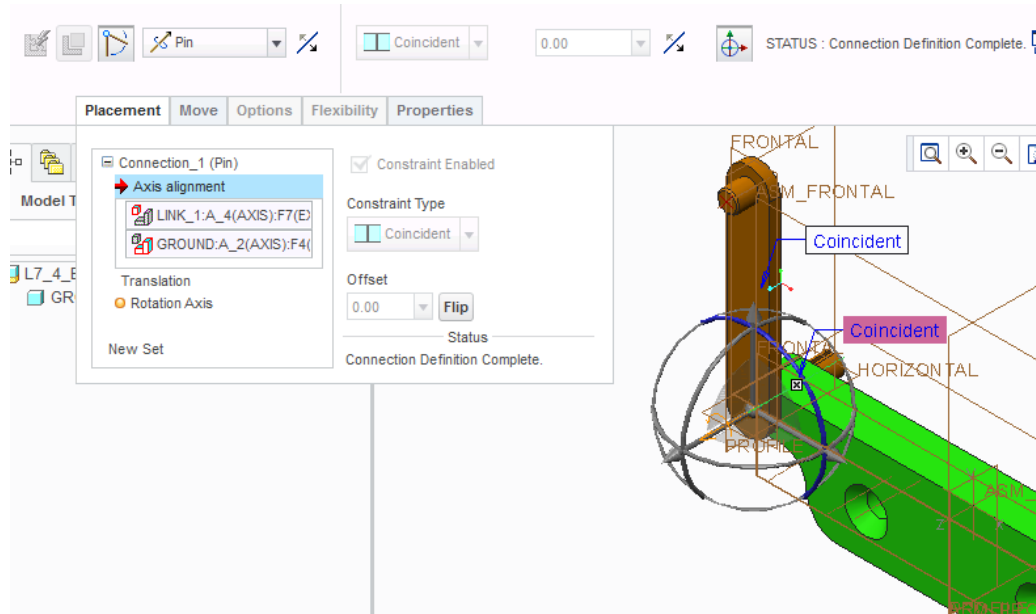
LINK 2

LINK 3

POINT B

Download parts ground, key, link_1, link_2, link_3 and pulley from the V:/MET_306/Activity_8_Creo drive.

In assembly mode, assemble the links, starting with the Ground Link (horizontal link).

This link is assembled in a normal fashion, making sure it is fully constrained to the default datums.

Assemble Link 1. Create a pin connection and align the axis and define a translation Constraint for the mating surfaces. You do not need to set the Rotation Axis.


Assemble link 2. Do the same for this link, except the Assembly Reference for the Translation Constraint should be set as shown below.
After setting the constraint, select the Move button to Rotate the link to the position shown.
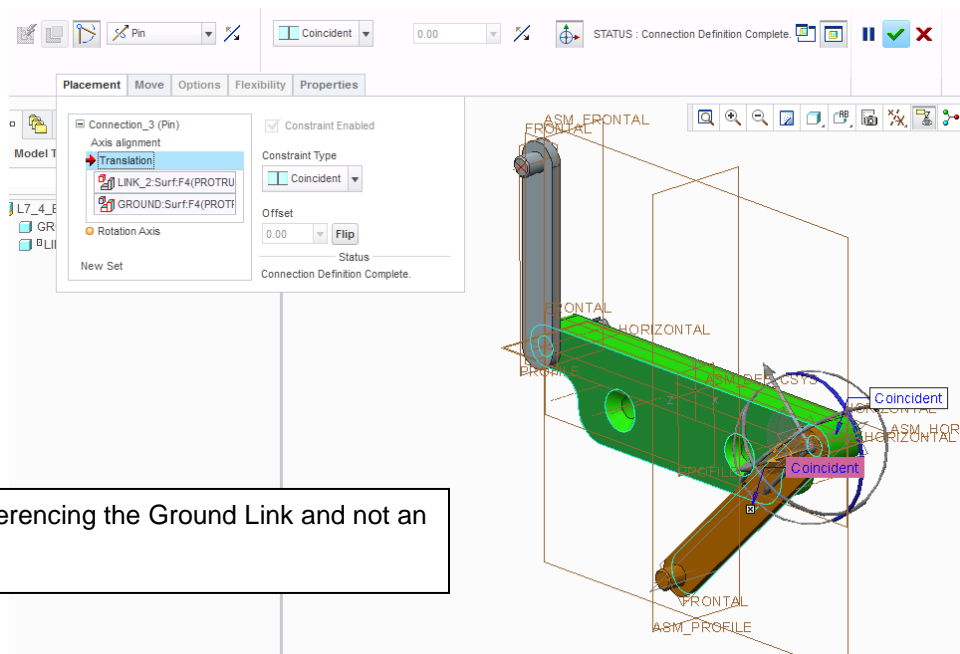
Make sure this is referencing the Ground Link and not an assembly plane.

Link 3 will have one planer and two cylinder connections. You don't have to define any translation or rotation constraints.
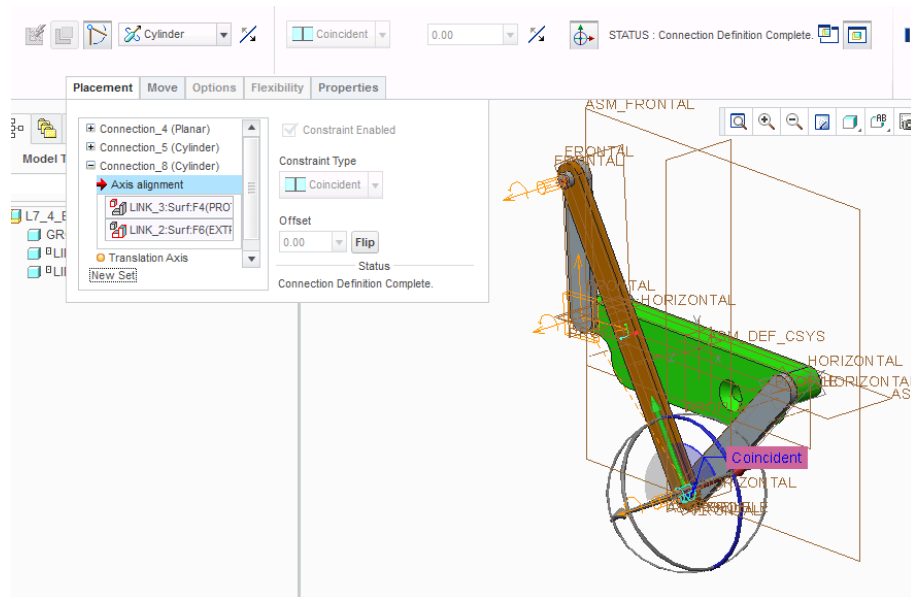
Enter Applications - Mechanism, and select the drag components tool under the Mechanism tab.
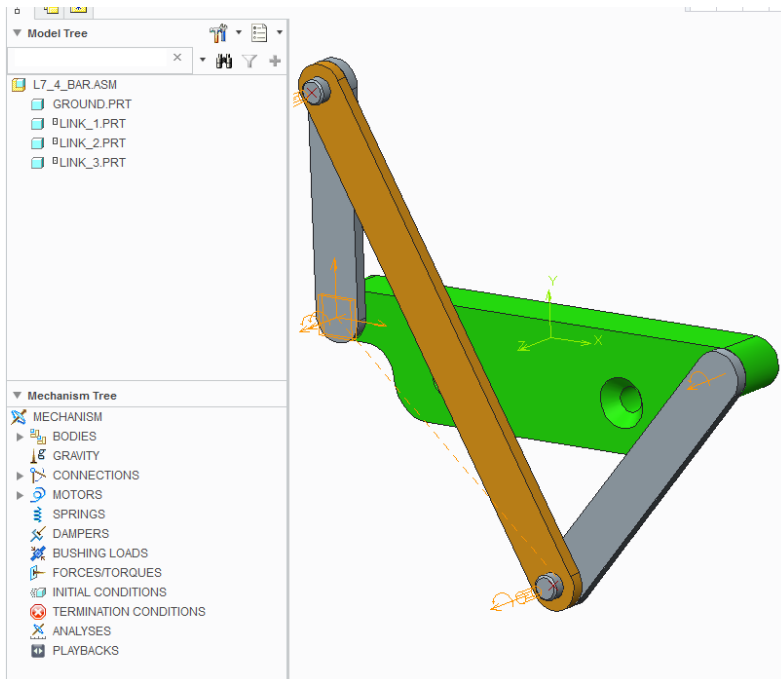
If your geometry is properly constrained, you should be able to drag link one around in a circular fashion, the other links following. You simply select a point on link 1.

If you can drag the mechanism around 360° return to Standard Applications and assemble the Pulley and Key, otherwise return redefine your constraints until the links can be dragged.

Check for Global Interferences (there should be none) and screen capture an image similar to what is shown with the prompt line message.
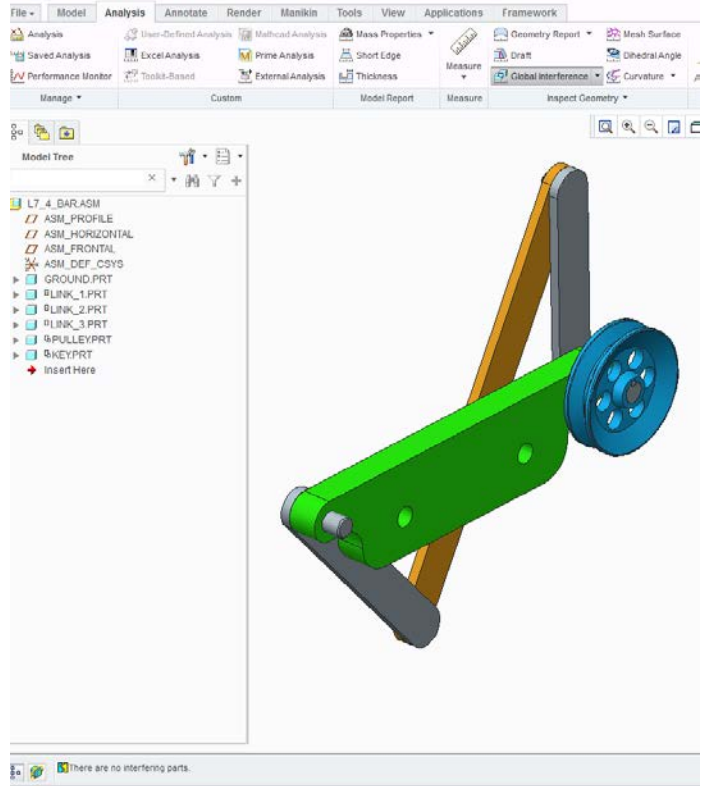
Re-enter Mechanism and define a servo motor (Insert region of the Mechanism tab) for Link 1.

Use the axis from link1 and the ground link for Motion Axis on the Type tab and use the Profile tab to set the Specification to Velocity, Initial Angle to where link1 is vertical and the Magnitude to a constant A of 10 deg/sec.

.
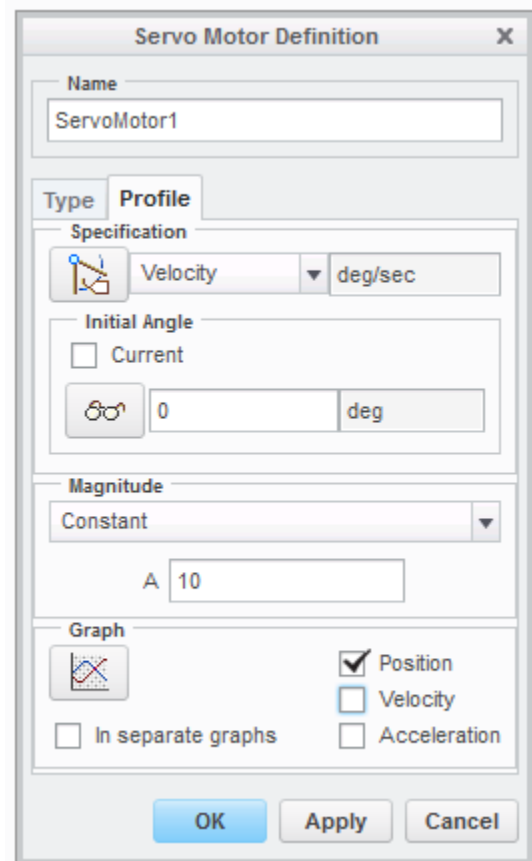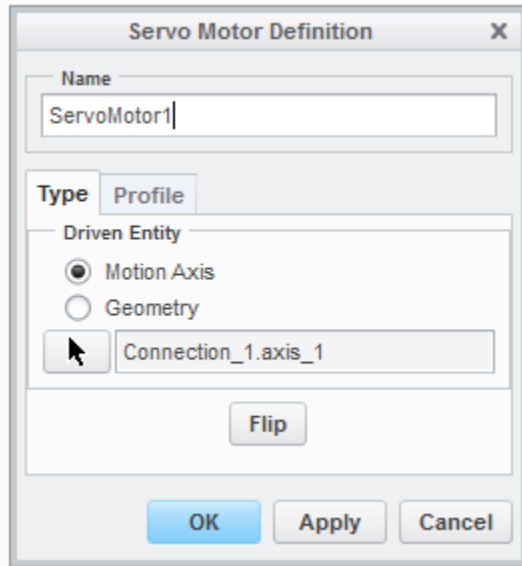
Note that the Initial Angle is set to 0 deg for the model shown (ie Link 1 **must** be vertical). You may have to set the Initial Angle to 90 or -90 or some other value in order to make your link vertical. Use the Eye glass icon (to the right of where you enter the angle) to see if your value is correct. If you change the angle of Link 1, the other links will not "re-assemble" themselves correctly until you "run" your linkage (instructions on the following page).

Use the Mechanism Analysis icon in the Analysis region of the Mechanism Tab to define the Preferences. Set the End time to 36 seconds for one revolution.

Select the Run button to play your motion definition. Link1 should start and end at the same location.

To make any changes to the Servo Motor or Analysis Definition, select Edit Definition from the Mechanism Tree.
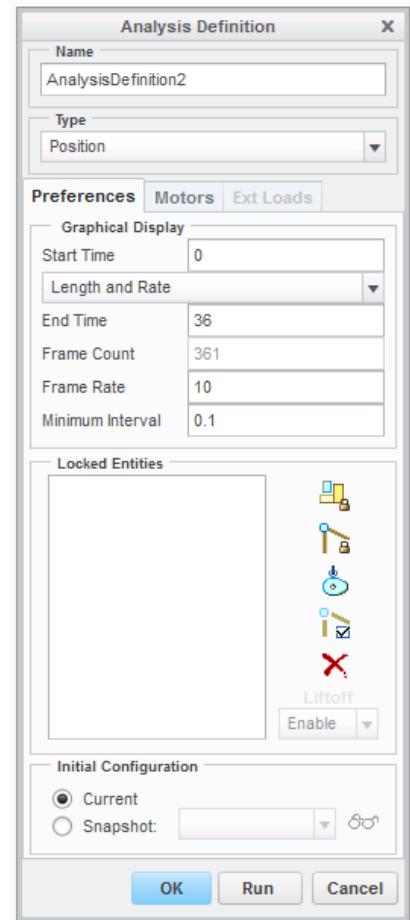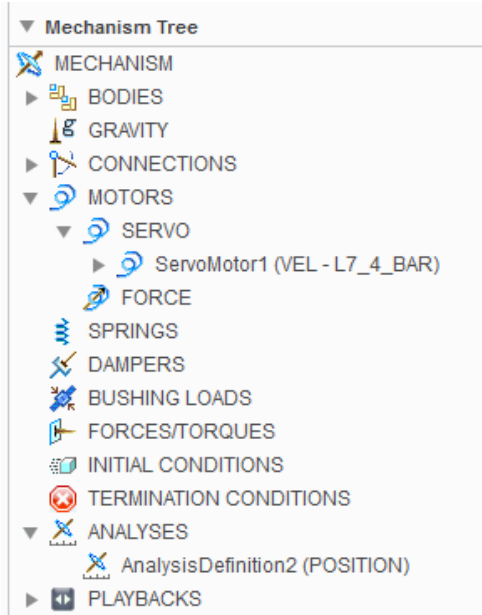
We wish to **verify** the results of Pro/E to be confident that we understand the results.

You will need to create a coordinate system offset from a coordinate system on the Ground Link. This is done outside of Mechanism, at the Assembly level. If this new coordinate system is not offset, then the coordinate system may rotate with Link 1.

A point (point A) is already established at the end of the link at intersection of the axis and surface. This point was created at the part level. An assembly point will not move with the link.
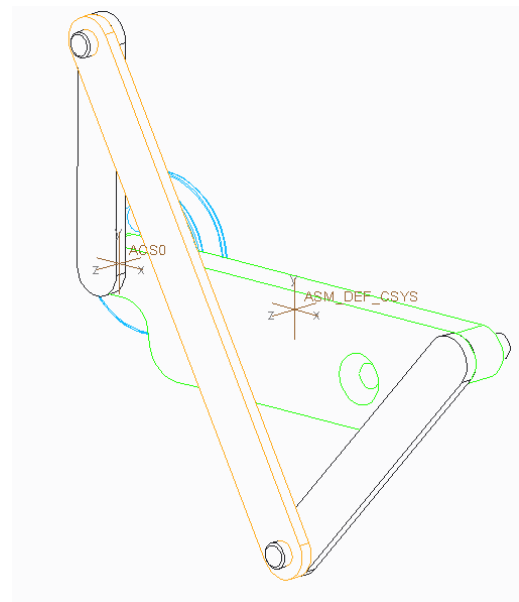
Select the Measures icon in the Analysis area of the Mechanism Tab to define
measures we wish to plot. We want the X and Y displacements of Point A
relative to the new coordinate system. Create two measures of type Position,
one for X and one for Y about this coordinate system. You need to have an
Analysis Set established (re-run your Mechanism Analysis).

Use Graph Selected Measures (graph icon) and generate a **singular** graph of the X and Y displacements
(Point Position Measure) of Point A **about** the rotation point of Link 1.

To change the title to include your name do a Format – Graph and on the Graph Display Tab modify the Label
to include your name
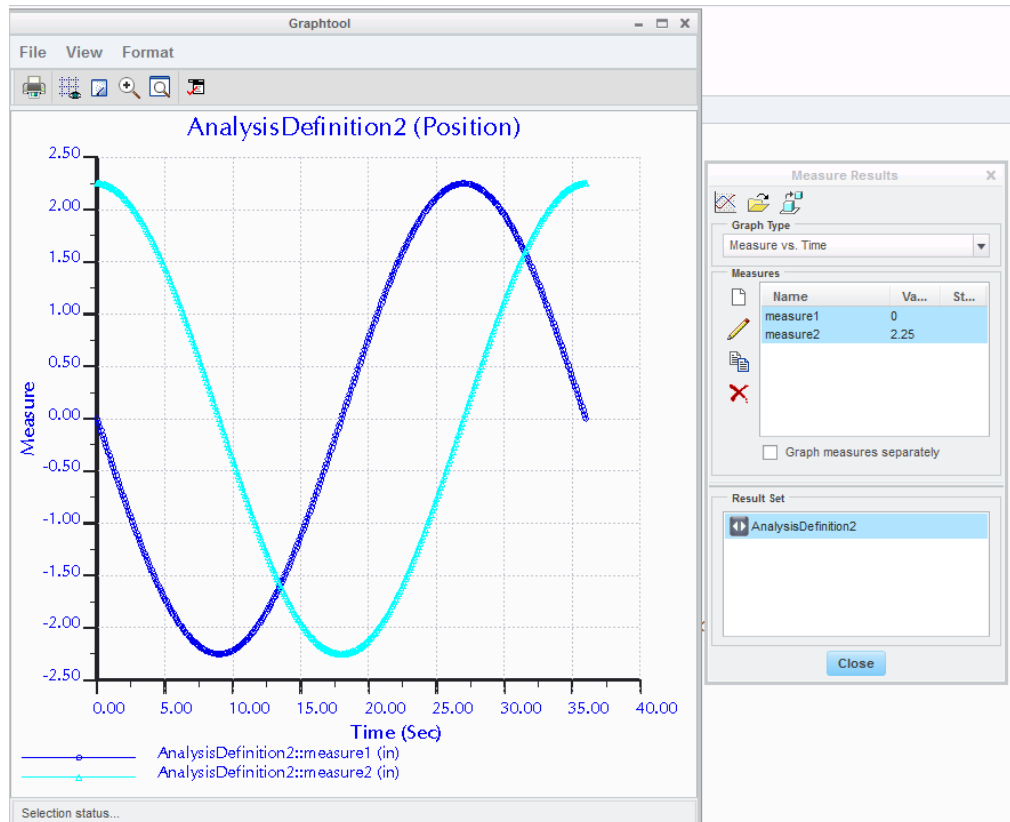
If your displacements are a straight line
or offset by some strange value, you
may be referencing an assembly datum
point or our assembly coordinate
system is incorrect (ie offset incorrectly
and rotating with a link because you
used the datum planes on link 1).

Question 1:
On this printed graph, explain how you know that the graphed values for X and Y are 100% correct. You will
have to hand print (i.e. not cursive) this in the white space on the graph. The answer is not one graph is a
sine curve and the other is a cosine curve.

.

Select the down arrow next to the Analysis region in the Mechanism tab. Pick on trace curve.
Set the Trace Curve options to be as shown and Preview the curve.
Screen capture this image and append it to the bottom of the screen capture done on page 4.
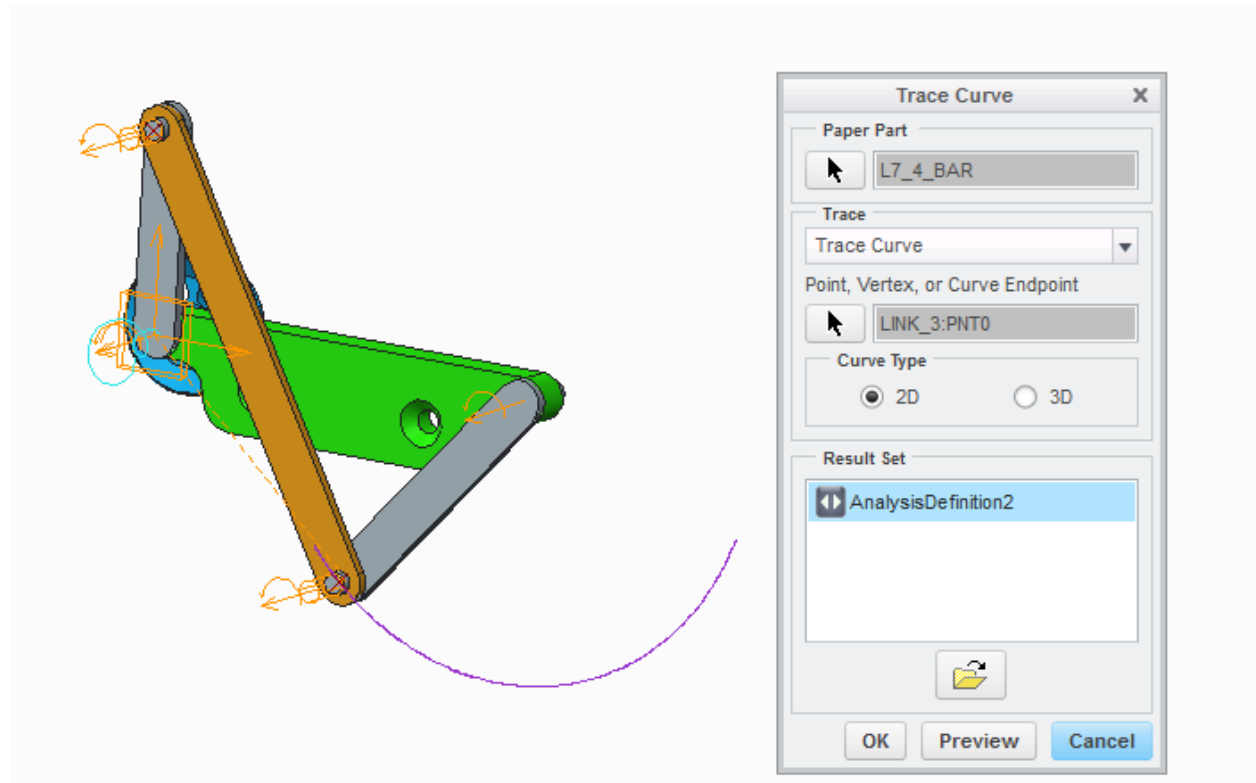
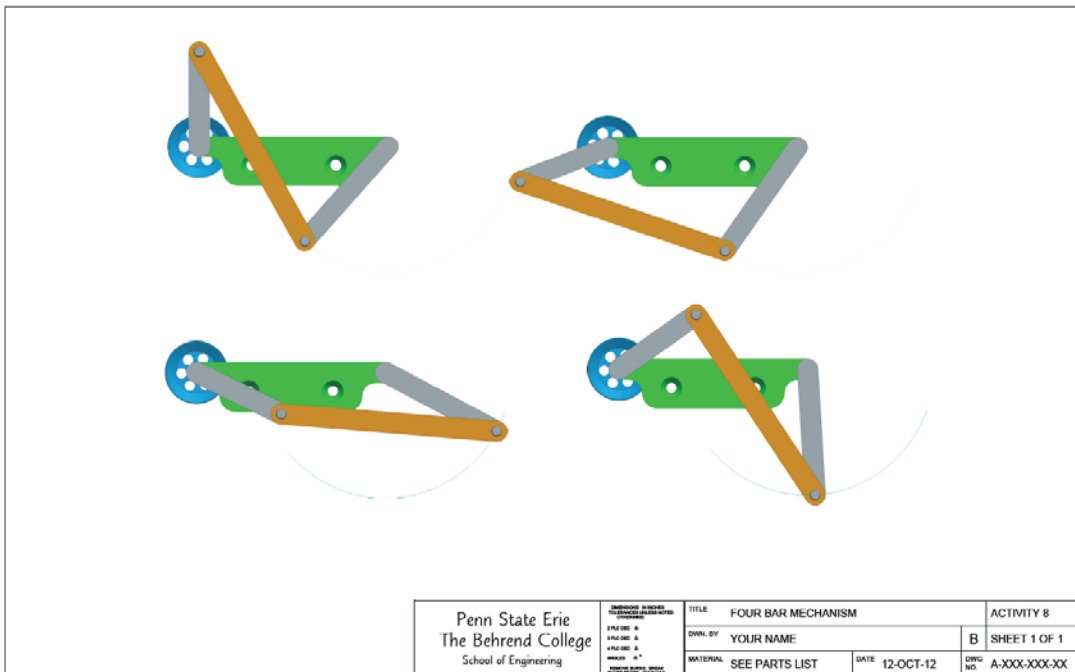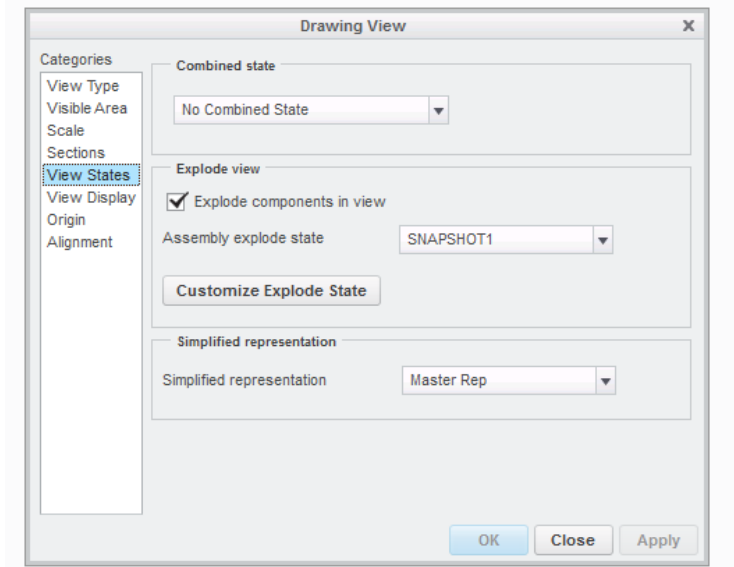Make snapshots of your mechanism moving. To do this, select the drag tool, and drag (Point Drag and select a point on the end of link 1) the mechanism to the desired position. Click the camera icon in the Drag Dialog box. This creates a snapshot of this configuration.

To make the snapshot available in drawing mode, select the snapshot and then pick on the second to last icon on the left side of the dialog box.
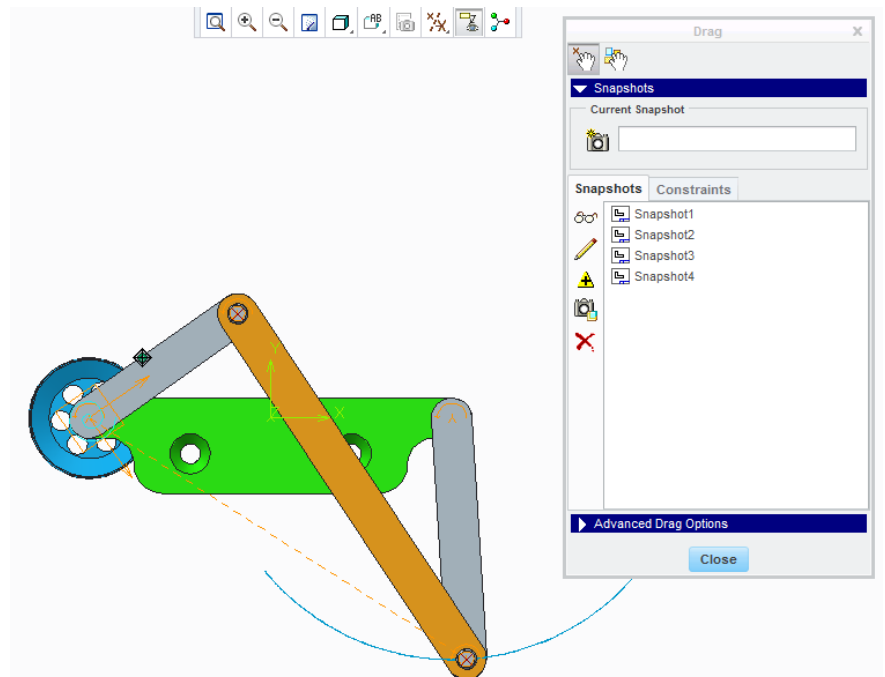
Create a B size drawing and create a General – Exploded view. Select the location, orient then check which snapshot you want from the View State (Explode components in view). Do this four times. Position the views so the ground links line up horizontally and vertically. Fill the page Publish this as a PDF. Print the file (drawing) in color on A size paper.

The trace curves are rather light.

Drawing View

Categories
View Type
Visible Area
Scale
Sections
View States
View Display
Origin
Alignment

Combined state

No Combined State

Explode view
☑ Explode components in view

Assembly explode state   SNAPSHOT1

Customize Explode State

Simplified representation

Simplified representation   Master Rep

OK   Close   Apply

Penn State Erie The Behrend College School of Engineering		TITLE	FOUR BAR MECHANISM		ACTIVITY 8
DWN. BY	YOUR NAME	B	SHEET 1 OF 1
MATERIAL	SEE PARTS LIST	DATE 12-OCT-12	DWG NO. A-XXX-XXX-XX

End Level 7

Begin Level 8.5
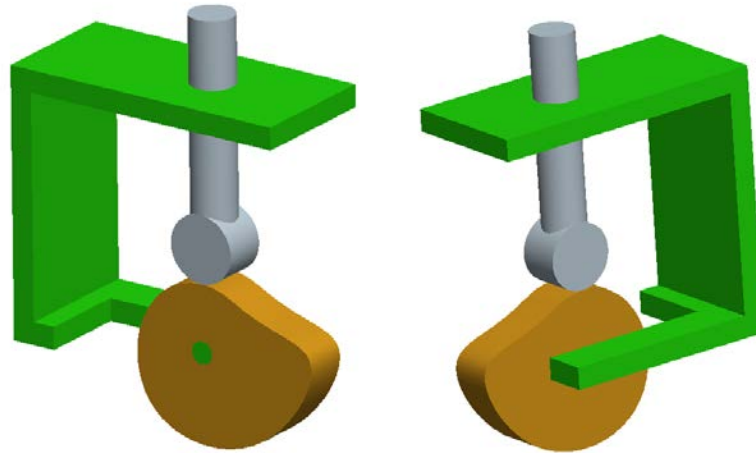
Build an inline roller-follower mechanism similar to the one shown above and assemble it and run it using Mechanism design.

Cam Design: The **first** 50 and the **last** 30 degrees **must** be a dwell with a radius of 1.5. The rest of the shape is optional.

Documentation:

1) Produce and print an B size drawing of the cam (front and right side views only) on A size paper using ordinate dimensions to locate the knot points. Hint: these points need to be dimensioned at the **sketch** level, so you can Show them in the drawing. The view shown below has had the dimensions "switched" so as to not influence the student. Make sure your dimensions have actual values. If ordinate dimensions "disappear" while editing, close the drawing window and re-open the file from the "In Session" folder
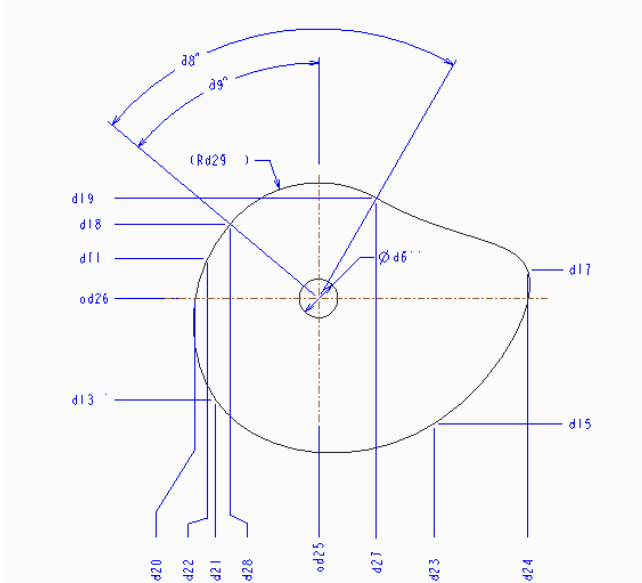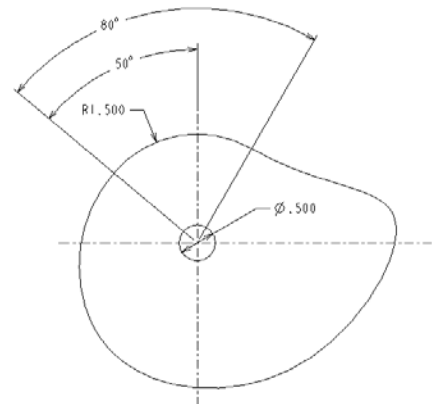
2) Create a B size (printed on A size paper) assembly drawing similar to the one shown below. The right most view is created by using Explode State (Manage Views option in the Model Display region of the Model tab) and generating offset lines. Remember to Save the Modified State (Edit drop down on the Explode tab in the View Manager) or the view will not explode at the drawing level.
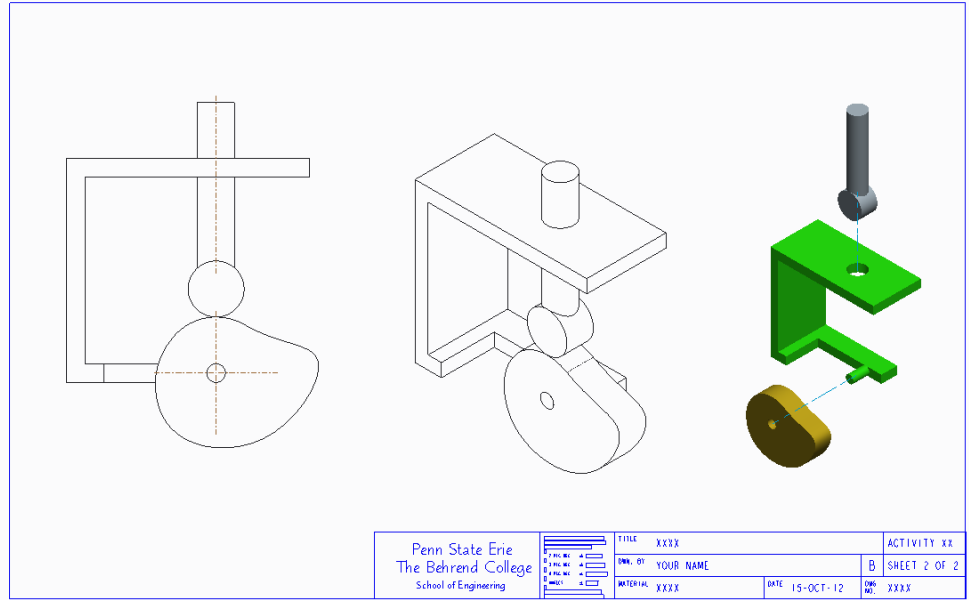
Fill the sheet!

3) Include a Y displacement plot of the **follower** (verses Time) for one complete revolution of the cam. Set the upper and lower bounds such that the displacement curve pretty much uses the available space on the graph.

4) Verify your displacement plot at a minimum of four locations using what ever method you choose. **This verification MUST include the dimensional values from the cam in order to be complete.**

Additional hints:

When initially constraining the follower, specify a **slider** constraint, aligning axis and rotation with datum planes. "Move" the slider well above where the cam is going to be located so you don't snap the bottom of the follower to the under side of the cam when doing the final "connection".

Read up on mechanism design by referring to the Precision LMS topic under cam design, The final "connection" is done in Mechanism, there is no provision during the assembly modeling process to define the Cam-Follower connection.

If you need to review Creating Explode Lines use Precision LMS.

End Level 8.5

Begin Level 12

This is not a misprint…. A gold doubloon (in this case two extra points) for the student who makes the effort to properly verify the CAD generated data, and does it **well**.

These instructions relate to the four bar linkage created for Level 7.

Generate a graph of the X and Y displacement of Point B about a select coordinate system. Print this.

Generate a velocity graph of Point B (Magnitude only). Print this.

Verify **both** of these graphs with Link 1 at 0 (defined as vertical), 45, 90, 135, 180, 225, 270 and 315 degrees. Use any method you wish, analytical, graphical or a mix of both. Draw on your background from your Dynamics class (or class lecture) to do this.

Hint: You MUST set the Type in the Analysis Definition to Dynamic to produce a velocity profile.

Include this documentation (verification calculations/drawings) making sure your results match those of Pro/E.

It is important that the documentation is both **easily** readable and understandable. Include a summary. Remember, Pro/E can output a tabular data set in Excel format. The **responsibility** for this lies with the student. **Do not assume** the person looking at this information is able to decipher some cryptic calculations or data files. Be professional.

Things to keep in mind: 2.5 of the 3.5 points possible for this portion of the assignment have to do with the documentation aspect.

End Level 12

Documentation

Level 7

Color screen capture page showing Global interference from page 4 and trace curve from page 7
X Y Displacement Graph with answer to Question 1
Detail Drawing (PDF file) showing four position of mechanism with trace curve (in color)

Level 8.5

B size Detail Drawing on A size paper of Cam
B size Assembly Drawing on A size paper
Y Displacement Graph of Follower
Displacement Verification Documentation

Level 12

X Y Displacement Graph of Point B
Velocity Graph of Point B
Verification Documentation including a one page Summary. The Summary is the **last** page in the document set.