#### Working Model Tutorial for Four Bar D Mechanism

1) Start Working Model 2D

2) Set display and units

Select View then Workspace

Check the X,Y Axes and Coordinates boxes and then select Close

X and Y indicator boxes showing cursor location will appear in the lower left corner

Select View then Numbers and Units then More Choices

Select Distance in Millimeters

Select Rotation in Radians and then select OK

Select View then View Size

Set Window width to 150 then select OK

3) Save this example

Select File then Save As

Choose a suitable folder and filename

Select Save

**REMEMBER TO SAVE YOUR WORK OFTEN!**

4) Draw the crank

Select the Rectangle drawing tool from the tool bar on the left

Observing the H and W indicator boxes, draw a rectangle that is 14 mm high by 2 mm wide

5) Resize the crank if necessary

Left-click on the crank to highlight it

Then left-click on the H indicator box and enter 14

Or left-click on the W indicator box and enter 2

Finally, left-click on the crank to redraw the new rectangle

6) Place points on the crank

Select the round Point Element drawing tool from the tool bar on the left

Position the cursor over the center of the lower edge of the crank

**WAIT** for a small X to appear to snap onto the center of that edge

Left-click to attach the point to the crank

Repeat to place a pointat the center of the top edge of the crank

7) Label the crank

Left-click on the crank to highlight it

Select Window then Appearance

Remove the check on the Track outline box

##### Check the Show name box

Left-click on the box that says Rectangle and enter the name Crank

Left-click on the point at the bottom of the crank

Remove the check on the Track center of mass box

Check the Show name box

Left-click on the box that says Point and type the name A

Repeat to name the point at the top edge as B

8) Draw and label the follower

Repeat steps 4) through 7) to draw a follower that is 20 mm high by 2 mm wide with name Follower and with points C at the bottom and D at the top

9) Draw the coupler

###### Move the crank and follower away from the origin and y-axis

Select the Polygon drawing tool from the tool bar on the left

Left-click on the origin for the first vertex

Observing the DX and DY indicator boxes, move the cursor to DX= 0, DY= 71

Left-click to place the second vertex

Repeat to place the third vertex at DX= 4, DY= -2

Repeat to place the fourth vertex at DX= -2, DY= 0

Repeat to place the fifth vertex at DX= 0, DY= -69

Double left-click to complete the Polygon

10) Resize the coupler if necessary

Left-click on the coupler to highlight it

Select Window then Geometry

Edit the table at the bottom of the Geometry pop-up to match the following table

|  |  |  |
| --- | --- | --- |
|  | X | Y |
| 1 | 0 | 0 |
| 2 | 0 | 71 |
| 3 | 4 | 69 |
| 4 | 2 | 69 |
| 5 | 2 | 0 |

11) Place points on the coupler

Select the round Point Element drawing tool from the tool bar on the left

Position the cursor over the center of the lower edge of the coupler

**WAIT** for a small X to appear to snap onto the center of that edge

Left-click to attach the point to the coupler

##### Repeat to place a point at the sharp tip at the top of the coupler

##### Repeat to place a point near the center of the coupler but not on an edge

##### The small X will not appear

Double left-click on the point to show the Properties pop-up

##### Change the Global Coordinates for this point to X= 1, Y= 33

12) Label the coupler

Repeat step 7) to label the coupler as Coupler with points B at the bottom, C in the middle and P the sharp tip

For point P, check the Track connect box

13) Place the ground pin

**Move the crank, follower and coupler away from the origin**

Select the round Pin Joint drawing tool

Position the icon at X= 17, Y= 32 and left-click to place the ground pin

##### If necessary, double left-click on the icon to show the Properties pop-up

Manually change the location to X= 17, Y= 32

14) Place the motor

Select the round Motor drawing tool

Position the icon at the origin and left-click to place the motor

##### 15) Connect the motor to the crank

Left-click on the motor to highlight it

Select Split from the tool bar on the left

Left-click on the **CENTER** of the motor and drag the ground point onto point A on the crank

A dotted line should show this connection

Select Join from the tool bar on the left

The crank is now connected to the motor at point A

You should be able to left-click and drag the crank to rotate it about the motor

##### 16) Connect the ground pin to the follower

Left-click on the ground pin to highlight it

Hold down the Shift Key and left-click on point D on the follower to highlight it also

Select the Join button from the tool bar on the left to create a revolute joint

The follower is now connected to the ground by a pin joint D

You should be able to left-click and drag the follower to rotate it about the ground pin

##### 17) Connect the crank to the coupler

Left-click on point B on the crank

Hold down the Shift Key and left-click on point B on the coupler to highlight it also

Select the Join button from the tool bar on the left to create a revolute joint

The crank is now connected to the coupler by pin joint B

You should be able to left-click and drag on either link to rotate them

18) Connect the coupler to the follower

Repeat step 17) to connect point C on the coupler to point C on the follower

The coupler is now connected to the follower by pin joint C

You should be able to left-click and drag on any link to move the linkage

19) Changing initial assembly configuration

Left-click on any pin joint to highlight it

Select Split from the tool bar on the left

Left-click and drag any link to a more desirable position

Select Join from the tool bar on the left to reconnect that pin joint

20) Animate the linkage by selecting Run

Stop the animation by selecting Stop

Select World then Erase Track to clear messy animations

21) Changing animation speed

Select World then Accuracy

Smaller values for the upper box under Animation Step provide slower animation

22) Changing motor speed

Double left-click on the motor to show the Properties pop-up

Use positive velocity values for CCW rotation and negative velocity values for CW rotation

23) Displaying numerical data

Left-click on the follower to highlight it

Select Measure then P-V-A then Rotation

Select Run

24) Exporting data

Select File then Export

##### Choose a suitable folder and filename

Select Export type Meter Data (\*.dta)

Select Export

\*.dta files contain tab-delimited text and may be opened with Notepad, Word or Excel

Exporting video animation into \*.avi files may cause problems with exporting \*.dta files in future runs.



film path

3 mm

AB = 14 mm

BC = 33 mm

CD = 20 mm

AD = 17 mm X

 32 mm Y

69 mm