Problem Set No. 7   Assigned: 11/07/00
                                                       Due: 11/14/00

Problem 7.1
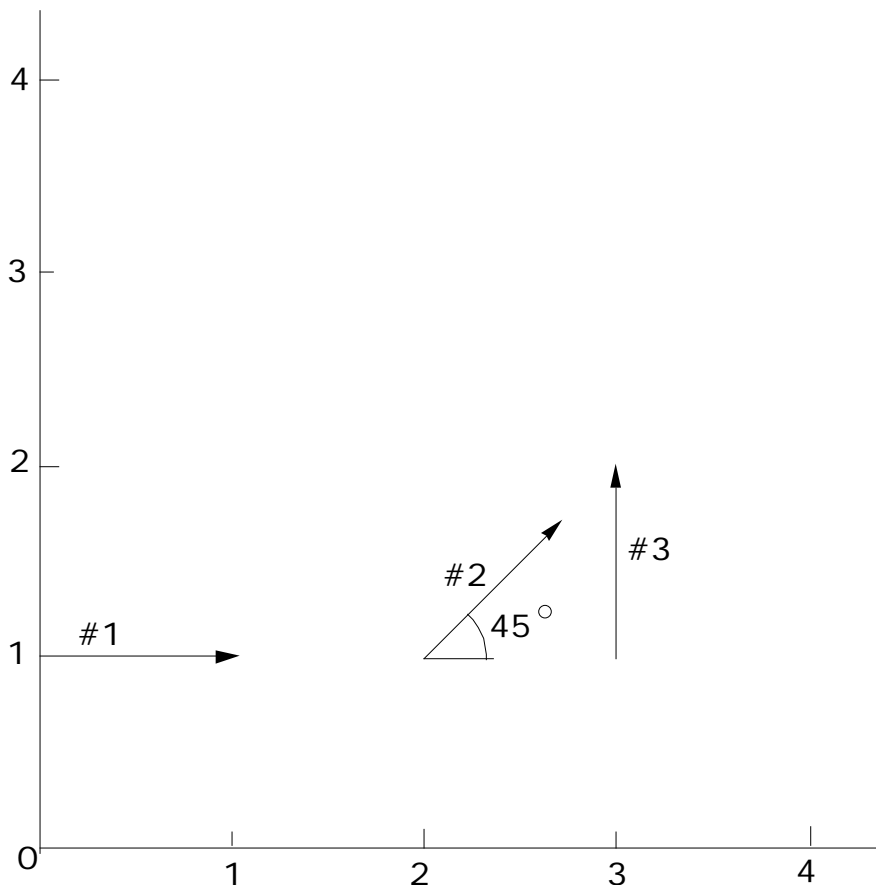
For the three positions of the plane shown above:
(a) Graphically find the fixed poles P_{12} and P_{23}.

(b) Graphically find the corresponding moving poles in position 1 - P_{12}^1 and P_{23}^1

(c) Analytically calculate the locations P_{12}, P_{23}, P_{12}^1 , P_{23}^1 and show these values on
      the diagram.
Show your work and calculations -- do your solutions agree?

Problem 7.2

A graduate student at a well known university has written a computer program that generated the circle and center point curves for four prescribed positions of a plane. The result of his program is shown in Figure 5.

(a) What are the properties of points which lie on the K1 and M curves?

(b) From these results how many points will have their positions nearly lying on straight lines? Explain how you arrived at your answer.

(c) Is there at least one point that moves in a straight line?

(d) If the points A1 and B1 were attached to the moving plane, locate on the Figure their positions as the moving plane moves to positions 2,3 and 4. What mistake has this graduate student made?
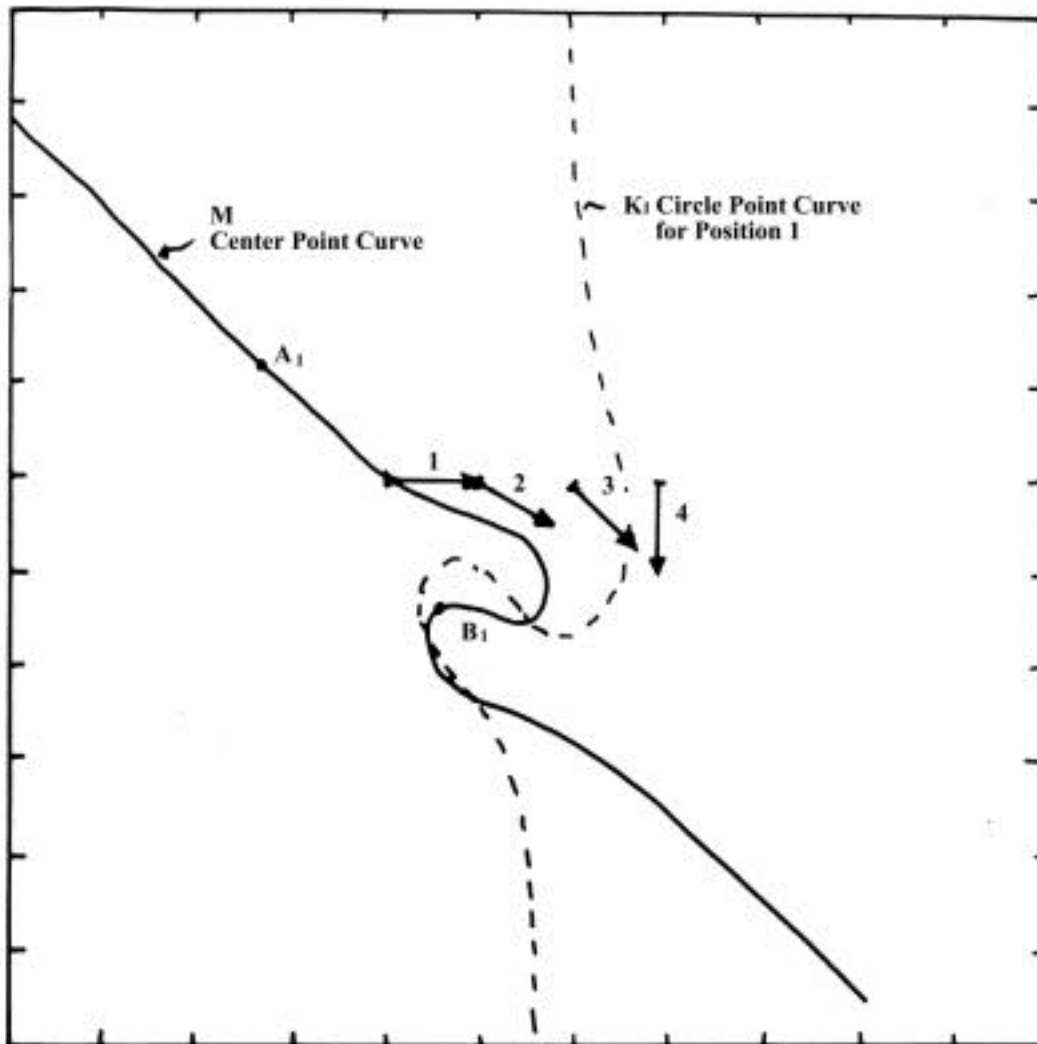

Figure 5.   Student's Program Results for Center point and Circle point Curves

Problem 7.3

Figure 1 shows the concept for a mechanism which is used to give an automobile windshield wiper a specified motion. This mechanism is not drawn to scale.
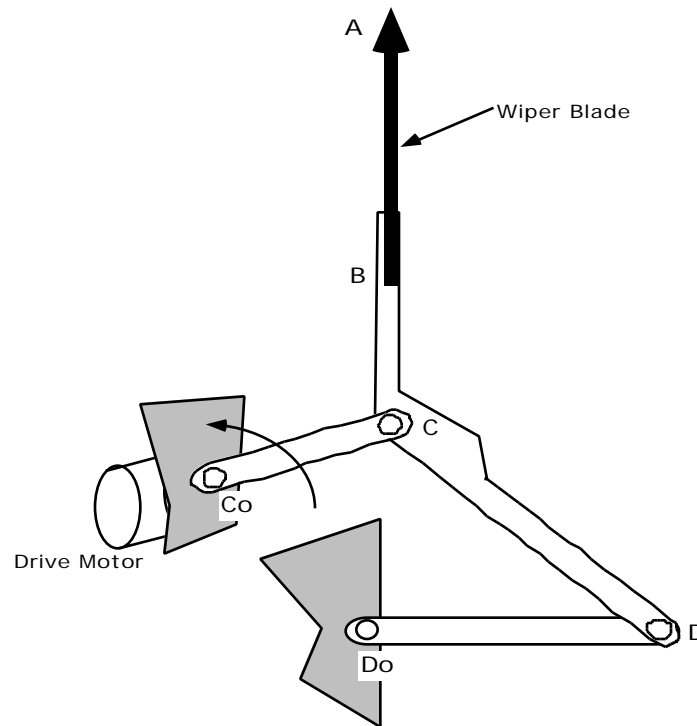

Figure 1.

The blade is to pass through the three positions shown in Figure 2. On the next page. Your fellow worker (George) was synthesizing this motion when he went on vacation. Your task is to finish the job.

a. George found the pole triangle shown in figure 2 (shown on the next page) and the position of point D in mechanism position 1, called D_1, as shown in Figure 2. Find the position D_0 on Figure 2.
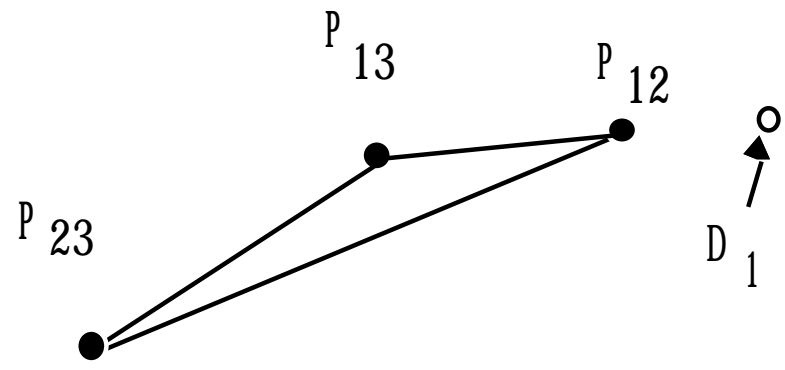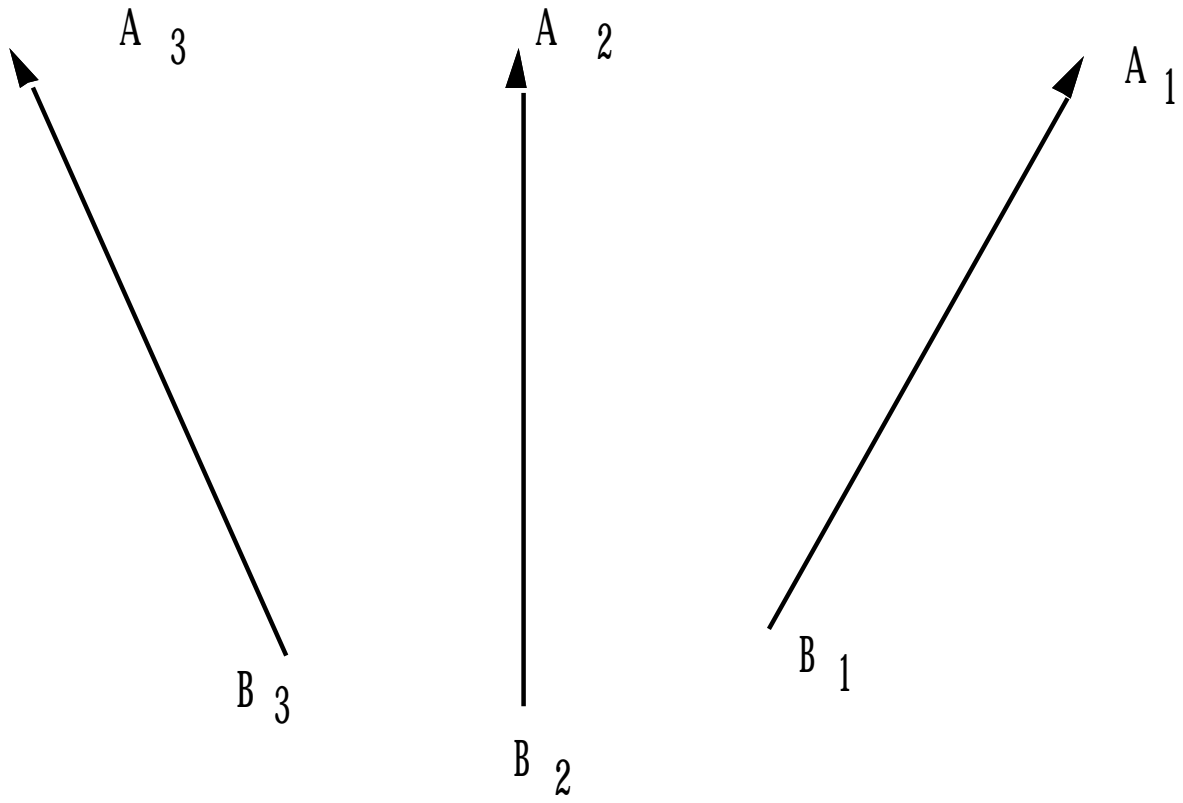
A_3

A_2

A_1

B_3

B_2

B_1

P_{13}

P_{12}

P_{23}

D_1

Figure 2

b. To finish the design C and C_0 need to be found. The boss wants a small mechanism. Find the C_1 and C_0 which will yield the smallest possible crank. Do your solution graphically on Figure 3.
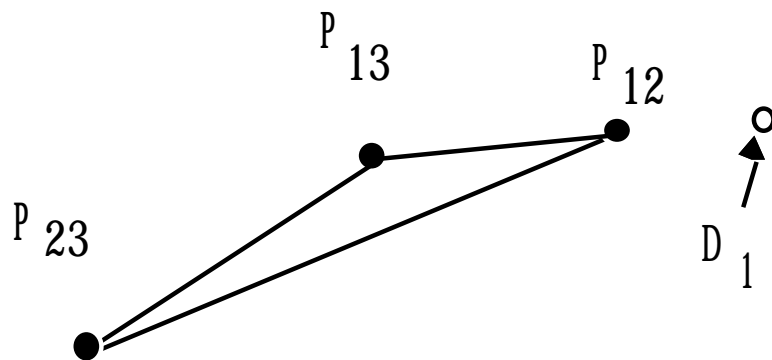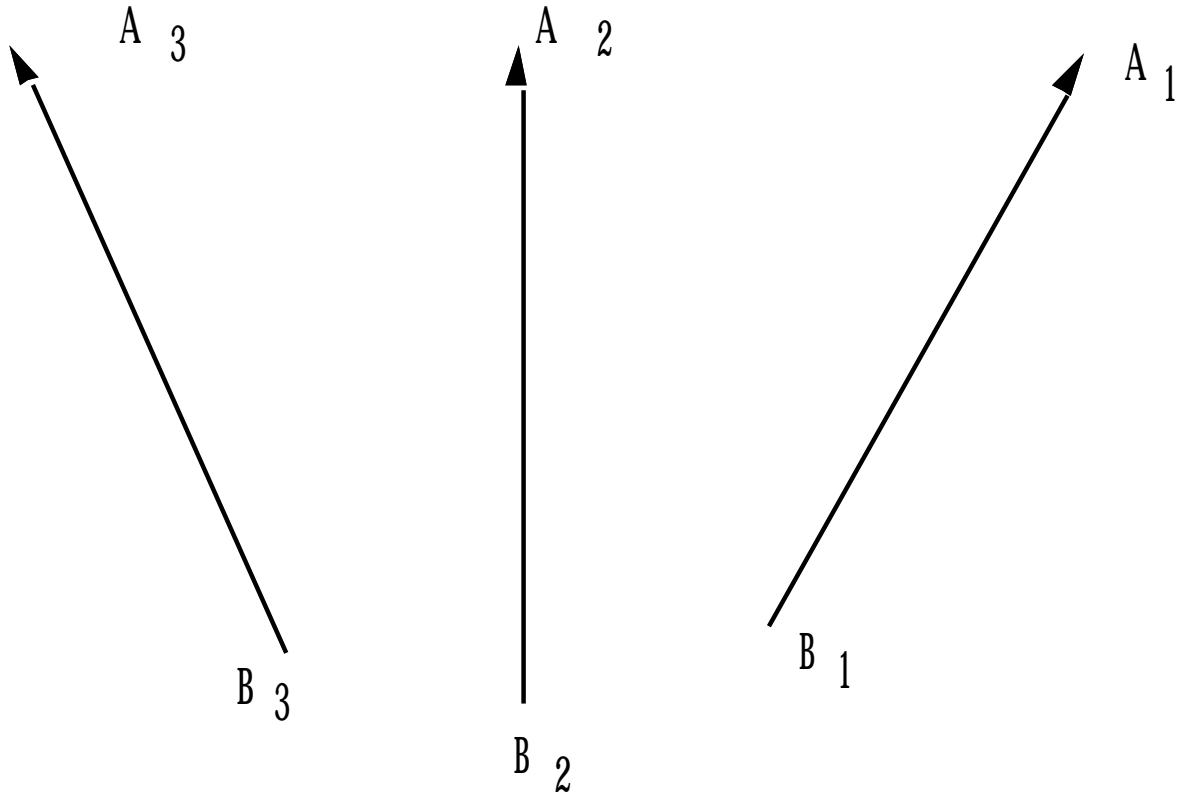
A 3

A 2

A 1

B 3

B 2

B 1

P 13

P 12

P 23

D 1

Figure 3

c. Show on Figure 3 the complete mechanism in position 1 and position 3. Does it satisfy the requirements for the mechanism?

Problem 7.4

a. In the above problem, what does your design guarantee about the motion of the blade between the three positions used in your synthesis?

b. The "Boss" thinks you will get better performance from using four positions and adds position 4 to your requirements, as shown in the figure below. Will the operation of your mechanism be disturbed by the fact that your positions are now not numbered in increasing order?

c. Find the poles P_{14} and P_{24} and using the poles you already have shown in the figure construct a fixed CPQ on the figure below. Use this CPQ to find **one** center point which is **not** a pole. Briefly discuss its possible use in the design of the windshield wiper mechanisms.