f. Find and plot the displacement of piston 4 and the angular displacement of link 3 as a function of the angular displacement of crank 2.

g. Find and plot the angular displacement of link 6 versus the angle of input link 2 as it is rotated from the position shown (+30°) to a vertical position (+90°). Find the toggle positions of this linkage in terms of the angle of link 2.

h. Find link 4's maximum displacement vertically downward from the position shown. What will the angle of input link 2 be at that position?

†4-19 For one revolution of driving link 2 of the walking-beam indexing and pick-and-place mechanism in Figure P4-6, find the horizontal stroke of link 3 for the portion of their motion where its tips are above the top of the platen. Express the stroke as a percentage of the crank length O_2A. What portion of a revolution of link 2 does this stroke correspond to? Also find the total angular displacement of link 6 over one revolution of link 2. The vertical distance from O_2 to the top of the platen is 64 mm. The vertical distance from line AD to the top left corner Q of the left-most pusher finger is 73 mm. The horizontal distance from point A to Q is 95 mm.

†4-20 Figure P4-7 shows a power hacksaw, used to cut metal. Link 5 pivots at O_5 and its weight forces the sawblade against the workpiece while the linkage moves the blade (link 4) back and forth on link 5 to cut the part. It is an offset slider-crank mechanism. The dimensions are shown in the figure. For one revolution of driving link 2 of the hacksaw mechanism on the cutting stroke, find and plot the horizontal stroke of the saw blade as a function of the angle of link 2.

*†4-21 For the linkage in Figure P4-8, find its limit (toggle) positions in terms of the angle of link O_2A referenced to the line of centers O_2O_4 when driven from link O_2A. Then calculate and plot the xy coordinates of coupler point P between those limits, referenced to the line of centers O_2O_4.

†4-22 For the walking beam mechanism of Figure P4-9, calculate and plot the x and y components of the position of the coupler point P for one complete revolution of the

† These problems are suited to solution using *Mathcad, Matlab,* or *TKSolver* equation solver programs. In most cases, your solution can be checked with program FOURBAR, SLIDER, or SIXBAR.

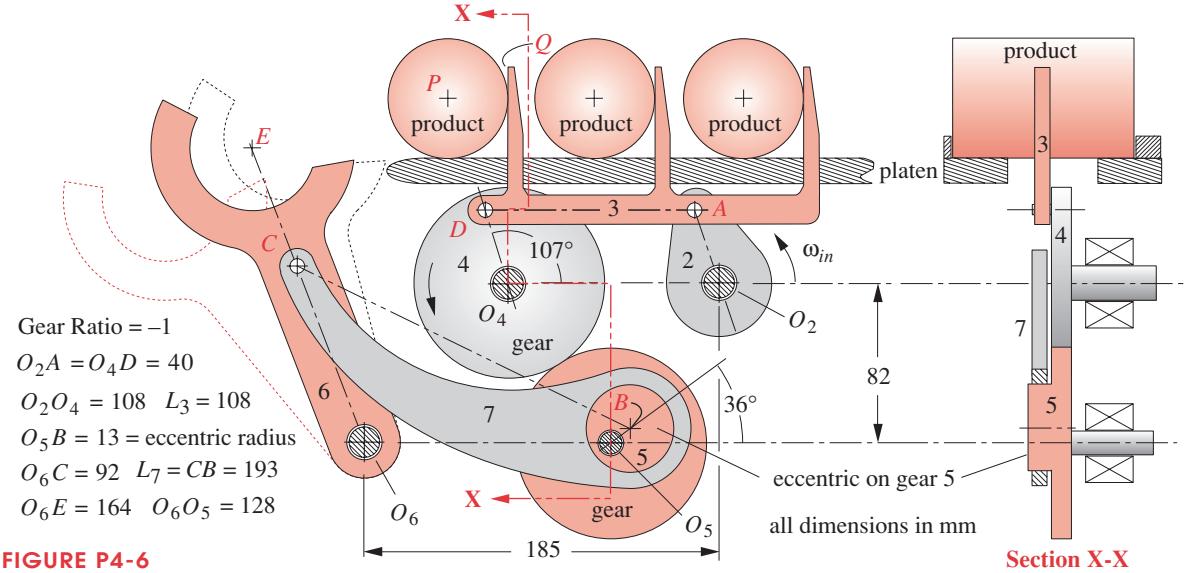

FIGURE P4-6

Problem 4-19 Walking-beam indexer with pick-and-place mechanism *Adapted from P. H. Hill and W. P. Rule. (1960). Mechanisms: Analysis and Design, with permission*