2.23. For the offset slider-crank mechanism shown in Fig. 2.53, calculate (*a*) the length of stroke of slider 4, (*b*) the distance O_2B when the slider is in its extreme left position, and (*c*) the time ratio of working stroke to return stroke.

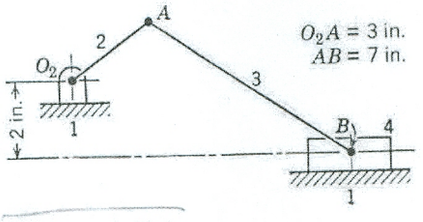
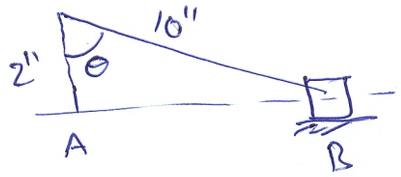
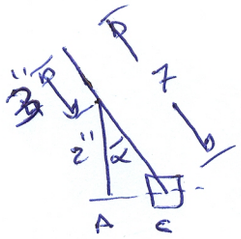


FIGURE 2.53

(a)





$AB = \sqrt{10^2 - 2^2} = \sqrt{96} = 9.8$ in

$AC = \sqrt{4^2 - 2^2} = \sqrt{12} = 3.46$"

$\Rightarrow$ stroke $= 9.8 - 3.46 = 6.34$"

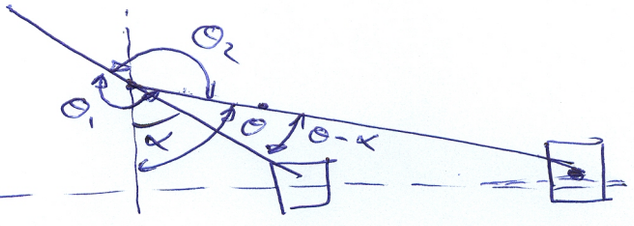
(b) 10"

(c) $\theta = \cos^{-1}\left(\frac{2}{10}\right) = 78.5°$

$\alpha = \cos^{-1}\left(\frac{2}{4}\right) = 60°$

$\theta - \alpha = 78.5 - 60$

$= 18.5°$



$\theta_2 = 180 - 18.5$

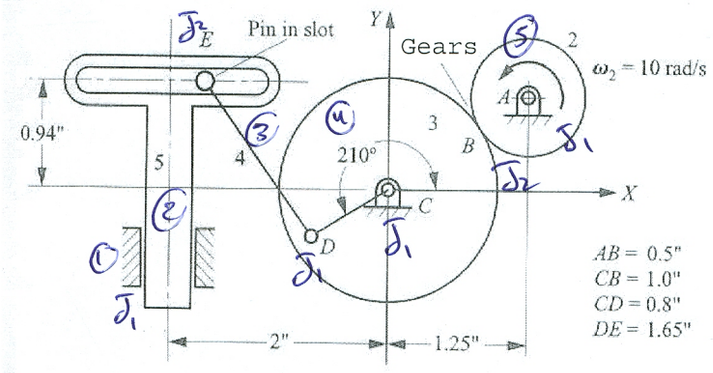
$\theta_1 = 180 + 18.5$

time ratio $= \frac{180 + 18.5}{180 - 18.5}$

$= 1.23$

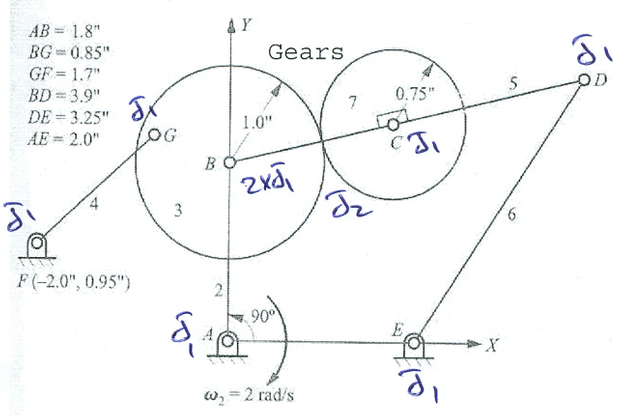
Solve problem 1.25 in the textbook. Also, for this problem determine the min. and max. transmission angles in case it is possible.

Find the D-O-F of the following mechanism



1- $n=5$; $J_1=4$; $J_2=2$

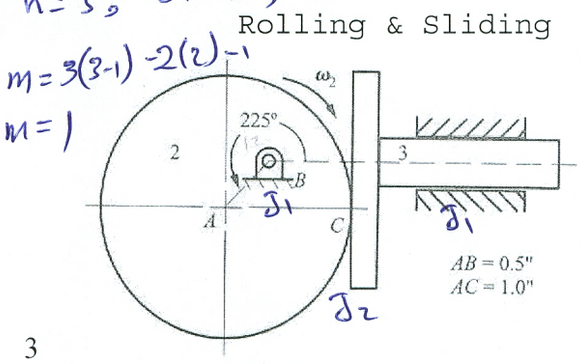
$m = 3(5-1)-2(4)-2 = 2$



2-

$n=7$; $J_1=8$; $J_2=1$

$m = 3(7-1)-2(8)-1 = 1$

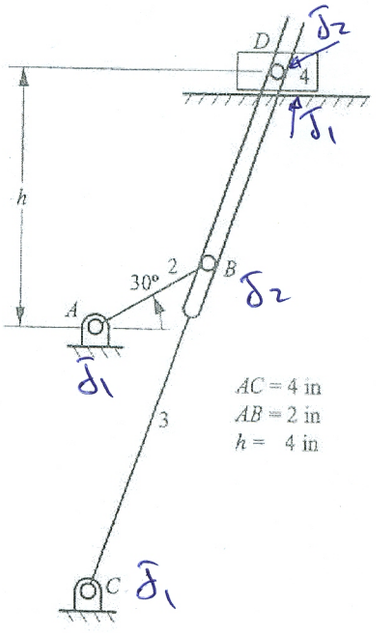


3

$n=3$; $J_1=2$; $J_2=1$

$m = 3(3-1)-2(2)-1$

$m = 1$



4

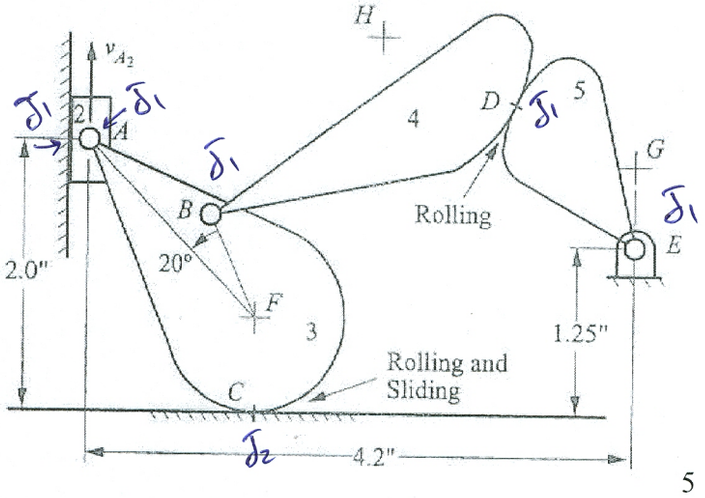
$n=4$

$J_1=3$

$J_2=2$

$m = 3(4-1)-2(3)-2$

$= 1$



5

$n=5$

$J_1=5$

$J_2=1$

$m = 3(5-1)-2(5)-1$

$= 1$

2.32. Find the range of angular positions for the input link (link 2) and for the output link (link 4) for the four-bar linkage shown in Fig. 2.57.

$\alpha = \tan^{-1}\left(\frac{6}{14}\right) = 23.2°$

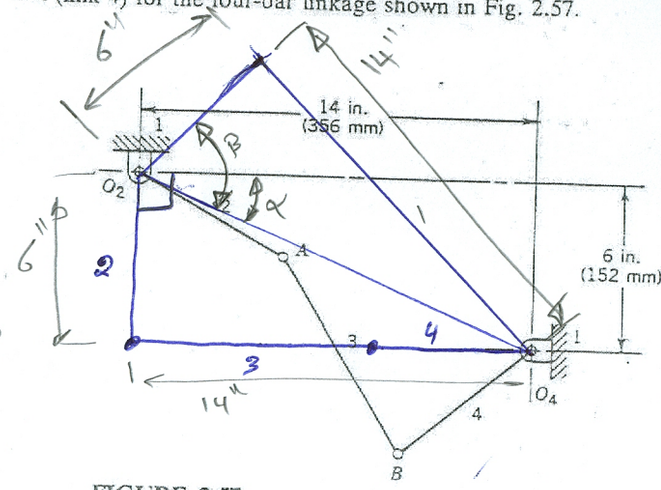
$O_2O_4 = \sqrt{14^2 + 6^2} = 15.2$

$\beta = \cos^{-1}\left(\frac{6^2 + 15.2^2 - 14^2}{2(6)(15.2)}\right)$

$\beta = 66.8°$

Range of motion for link 2

$= 90 + \beta - \alpha = 134°$



O_2A = 6 in. (152 mm)
AB = 8 in. (203 mm)
O_4B = 6 in. (152 mm)

FIGURE 2.57

1.11 Determine the mobility (number of degrees of freedom) of the devices shown in Figs. 1.25 through 1.32.

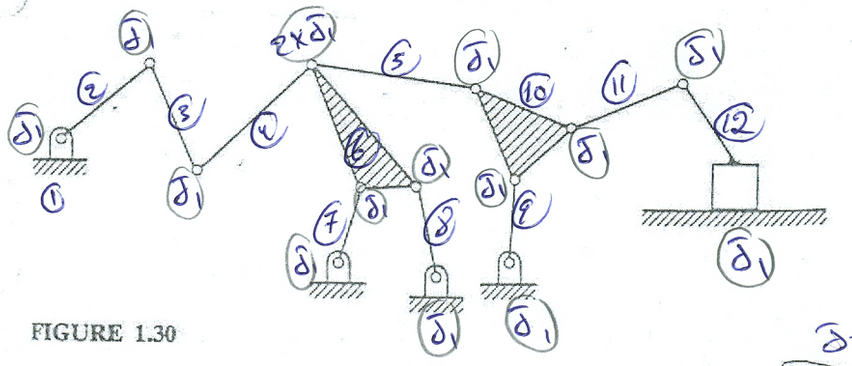


FIGURE 1.30

$n = 12$
$J_1 = 15$
$J_2 = 0$
$\Rightarrow m = 3(11) - 2(15) - 0$
$= 3$

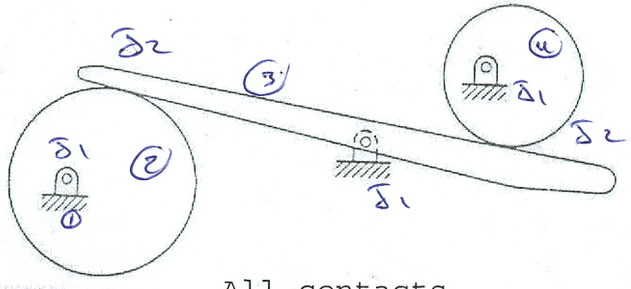


FIGURE 1.32

$n = 4$
$J_1 = 3$
$J_2 = 2$

$m = 3(4-1) - 2(3) - 2$
$= 9 - 6 - 2$
$= 1$

All contacts
Rolling & Sliding

1.25

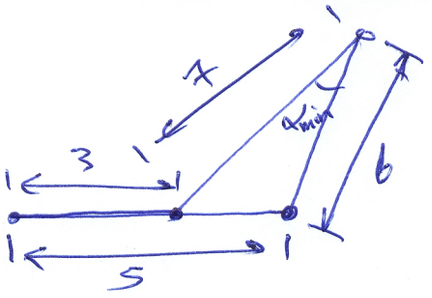
a) $S = 3$; $L = 7$; $P = 5$; $q = 6$

$S + L = 3 + 7 = 10$ $\quad$ $P + q = 5 + 6 = 11$

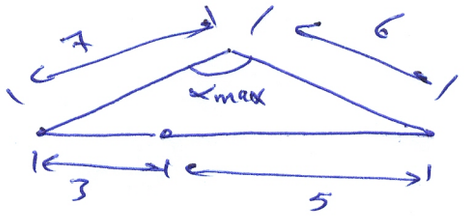
$S + L < P + q \Rightarrow$ at least one link makes complete rev.

Side link = shortest link $\Rightarrow$ Crank-rocker mechanism.

$$\alpha_{min} = \cos^{-1}\left(\frac{6^2 + 7^2 - 2^2}{2(6)(7)}\right) = 15.4^\circ$$



$$\alpha_{max} = \cos^{-1}\left(\frac{6^2 + 7^2 - 8^2}{2(6)(7)}\right) = 75.5^\circ$$



b) $S = 4$; $L = 8$; $q = 6$; $P = 7$

$S + L = 4 + 8 = 12$ $\quad$ $P + q = 7 + 6 = 13$

$S + L < P + q \Rightarrow$ at least one link makes comp. rev.

Shortest link = fixed $\Rightarrow$ double crank.

c) $S = 4$ $\quad$ $L = 8$ $\quad$ $P = 5$ $\quad$ $q = 6$

$S + L = 4 + 8 = 12$ $\quad$ $P + q = 5 + 6 = 1$

$S + L > P + q \Rightarrow$ triple rocker.