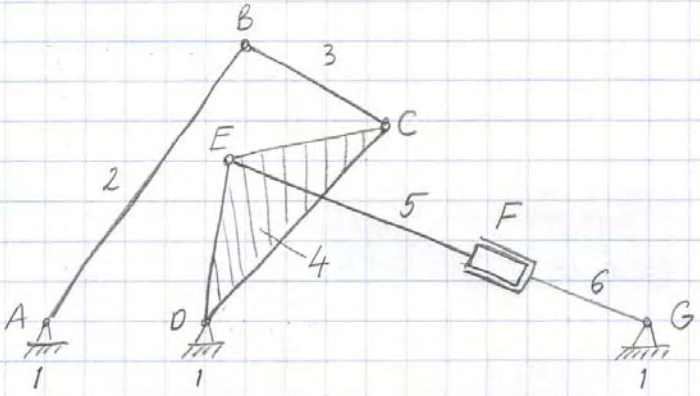
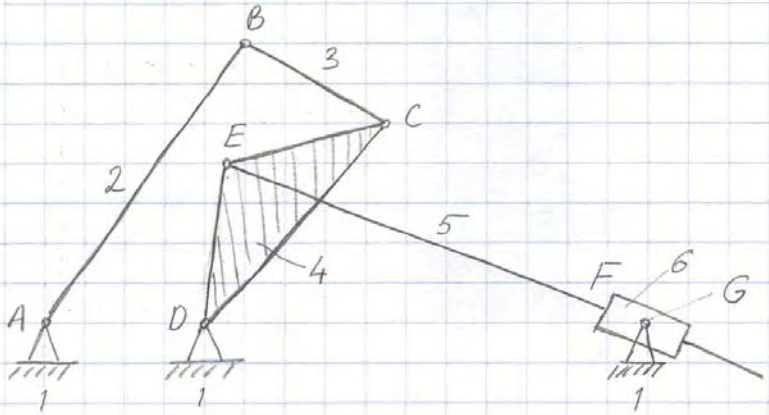
These are solutions to Problem Set 2.

Problem 1:



using a different symbol for the prismatic kinematic pair:



$n = 6$

$j_1 = 7$

$j_2 = 0$

mobility:

$m = 3(n-1) - 2j_1 - j_2 = 1$

The dump truck mechanism considered is a six-bar mechanism (linkage). Two equivalent kinematic diagrams are shown here (the only difference is in the symbol how the prismatic joint is represented.

Two "basic" linkages can be identified in the system:

- kinematic pairs ABCD and links 1234: form an RRRR four-bar mechanism
- kinematic pairs DEFG and links 1456: form an RRPR slider-crank mechanism

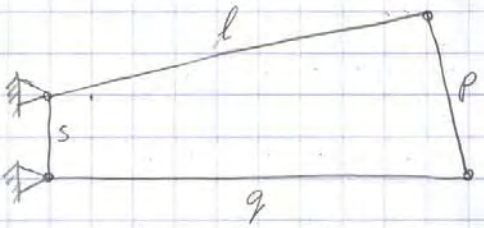
Problem 2:

Link lengths: 1 in, 3 in, 5 in, 5 in, $s = 1$ in, $l = 5$ in, $p = 3$ in, $q = 5$ in

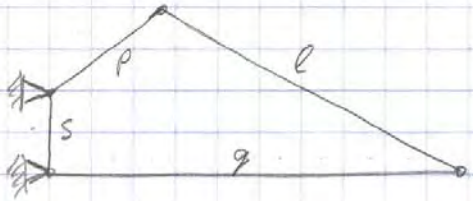
Grashof's law $s + l \leq p + q \rightarrow 5 + 1 < 3 + 5 \rightarrow$

→ all possible four-bar linkages assembled from these links will satisfy Grashof's law

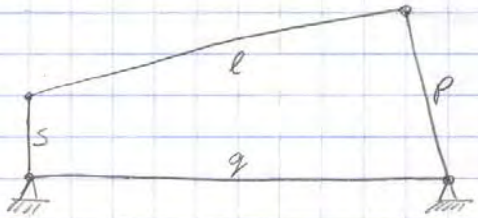
There are two possible ways to assemble the links. Inversions for each case are shown below: /not to scale/



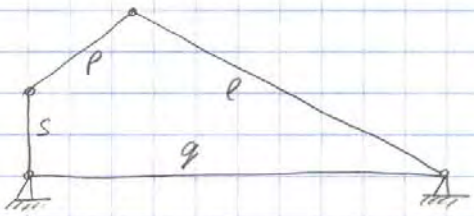
double-crank mechanism



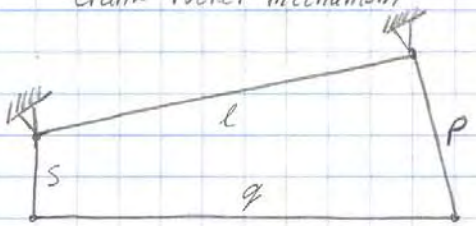
double-crank mechanism



crank-rocker mechanism

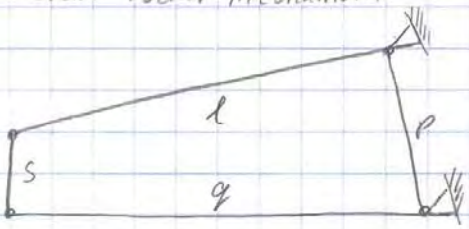


crank-rocker mechanism

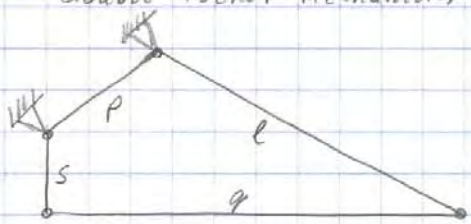


crank-rocker mechanism

double-rocker mechanism



double-rocker mechanism



crank-rocker mechanism

Problem 3

(a):

number of links: 6
number of one dof kinematic pairs: 7
number of two dof kinematic pairs: 0
there are no redundant kinematic pairs

$n = 6$
$j_1 = 7$
$j_2 = 0$

mobility: $m = 3(n-1) - 2j_1 - j_2 = 1$

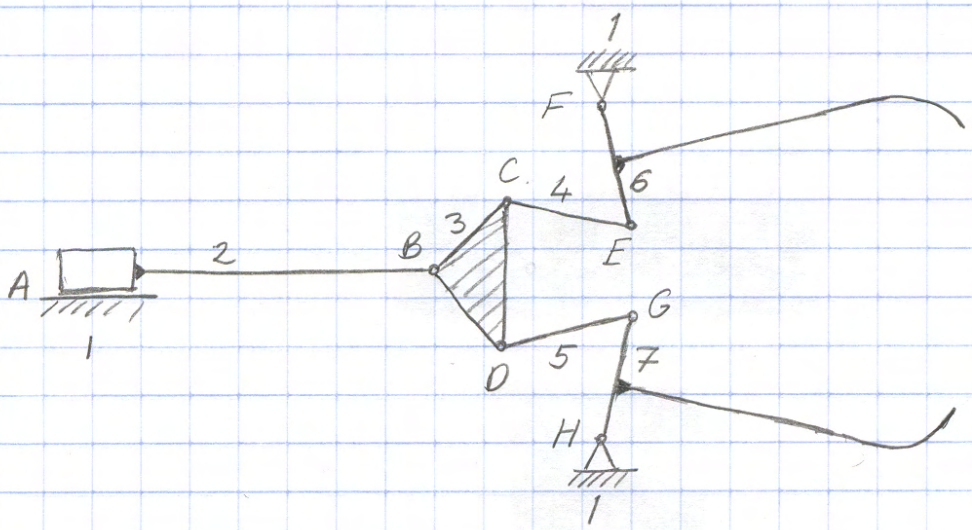
(b):

number of links: 8
number of one dof kinematic pairs: 10
number of two dof kinematic pairs: 0
there are no redundant kinematic pairs

$n = 8$
$j_1 = 10$
$j_2 = 0$

mobility: $m = 3(n-1) - 2j_1 - j_2 = 1$

Problem 4:



number of links : 7 $\quad n = 7$

number of one dof kinematic pairs : 8 $\quad j_1 = 8$

no two dof kinematic pairs $\quad j_2 = 0$

no redundant kinematic pairs

mobility: $m = 3(n-1) - 2j_1 - j_2 = 2$

there is only one actuator input at joint A $\longrightarrow$

$\longrightarrow$ underactuated mechanism