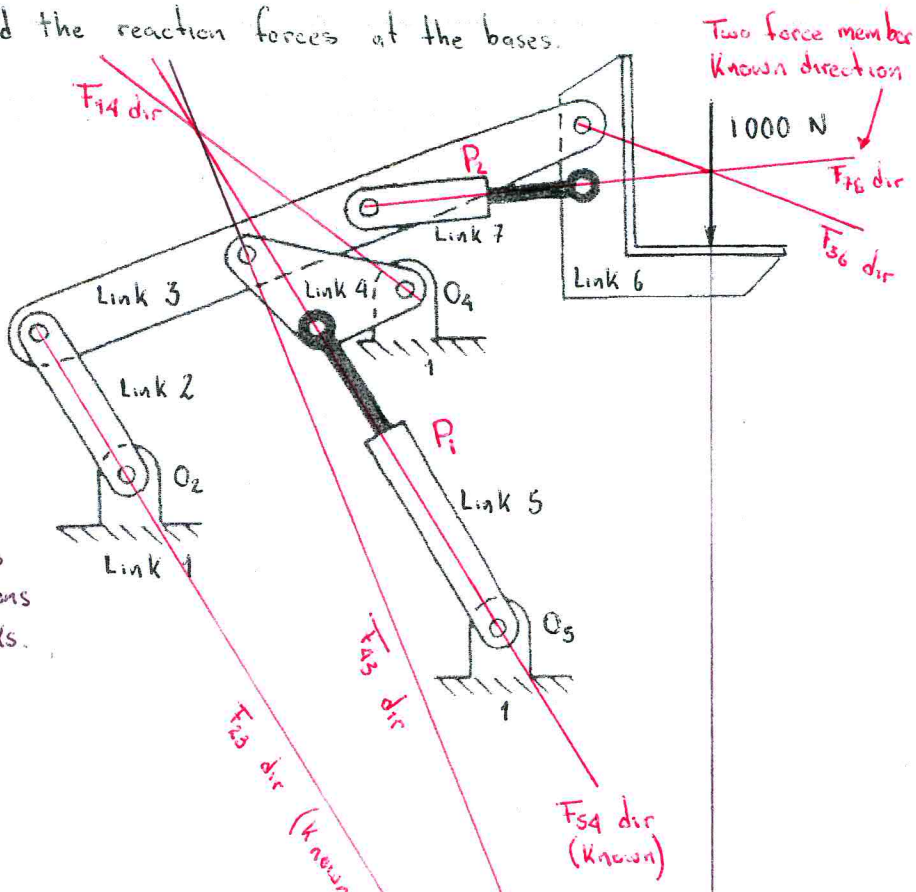
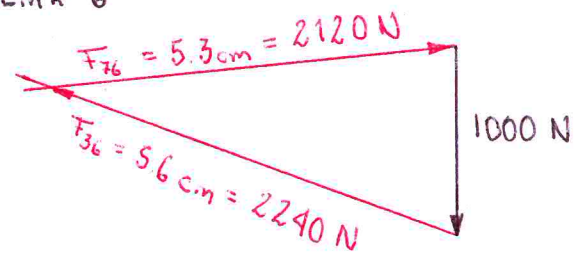
Example 4.4

Shown below is a front-end loader mechanism. Its mobility is 2 dof, with the prismatic joints being actuated. For static analysis, the prismatic joints act as two-force members. Find the required force in the actuators to maintain the static equilibrium and the reaction forces at the bases.



Scale 1cm = 400 N

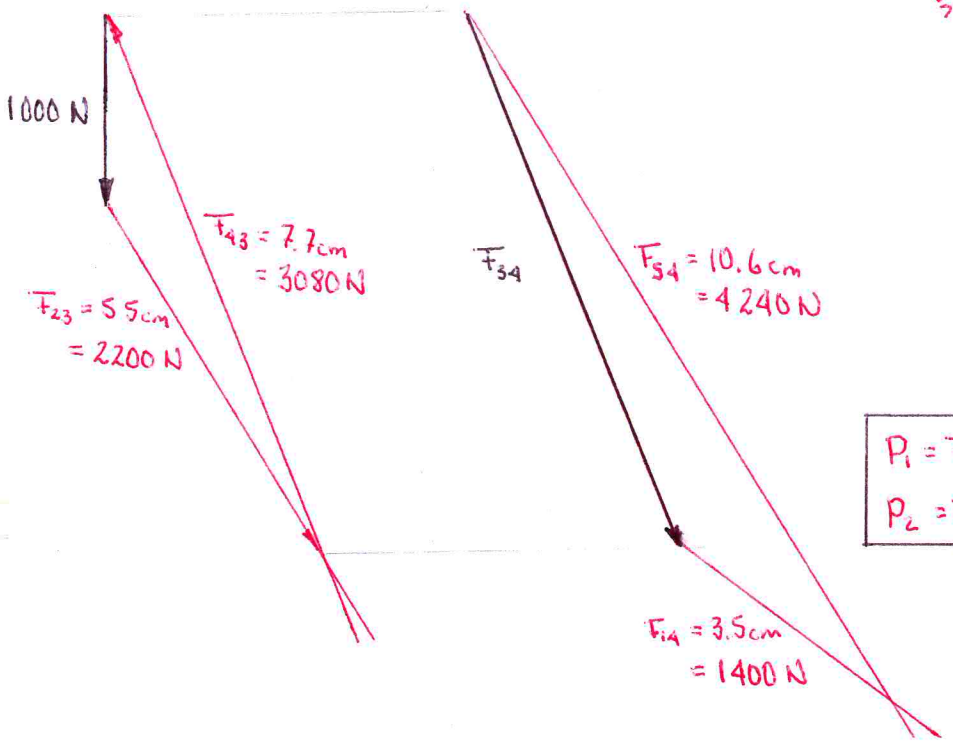
Link 6



Link 3 is a four-force member. We are going to consider links 3, 6, and 7 as a unique link (subsystem 3-6-7). This is possible because under static conditions there is no relative motion between links.

Subsystem 3-6-7

Link 4

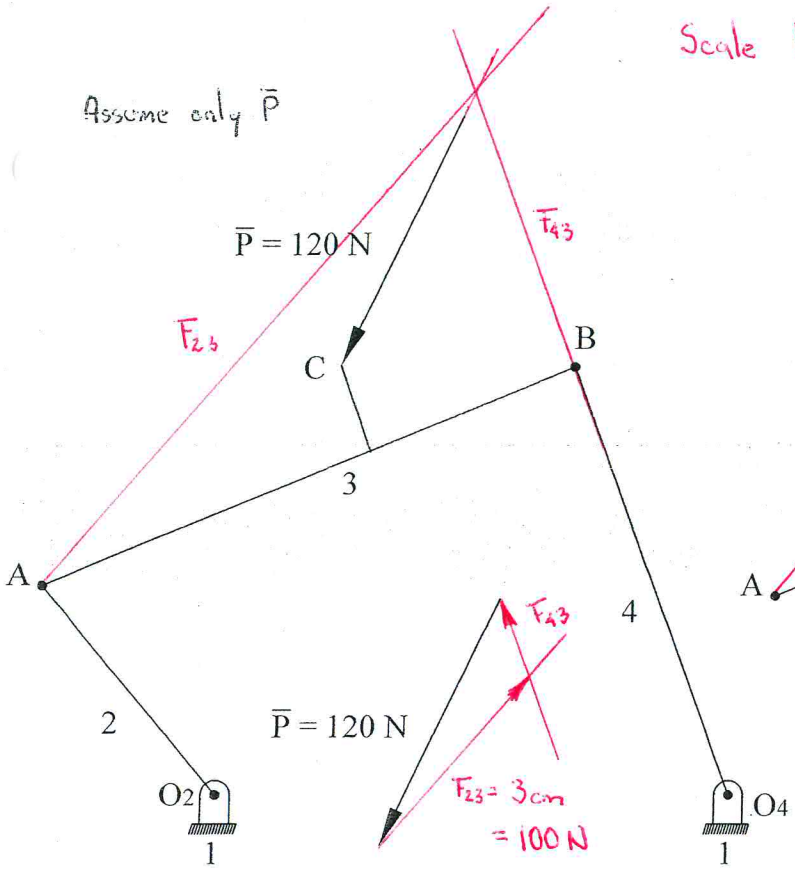


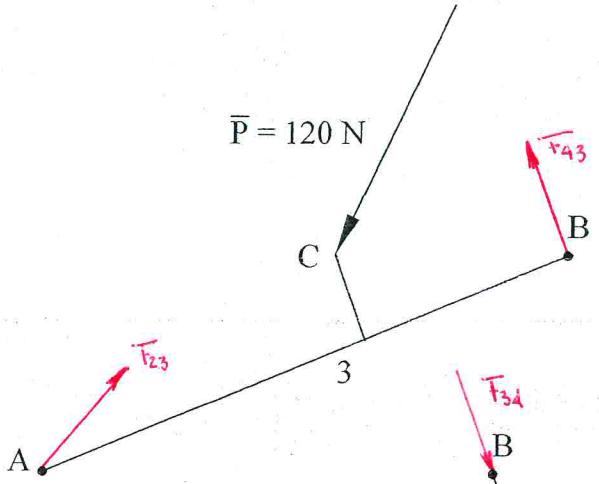
$P_1 = F_{54} = 4240\,N$

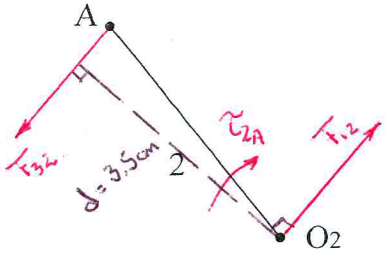
$P_2 = F_{76} = 2120\,N$

Scale 1cm = 33.3 N

Assume only $\bar{P}$

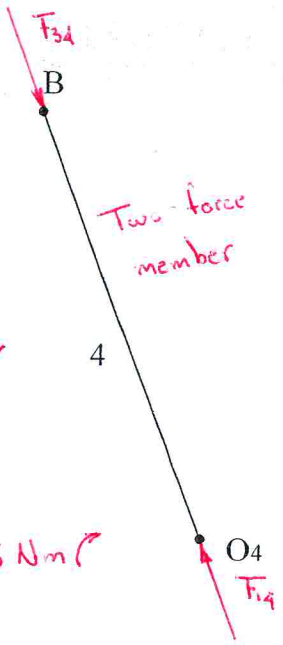




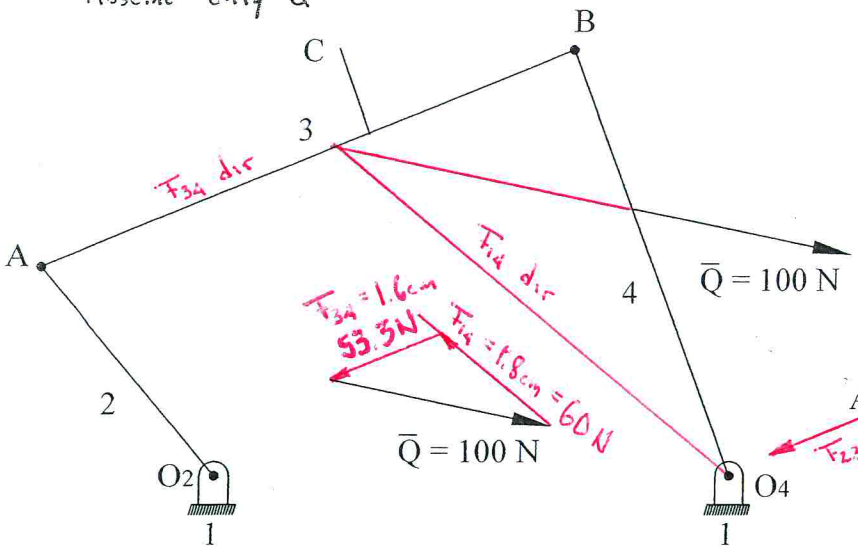


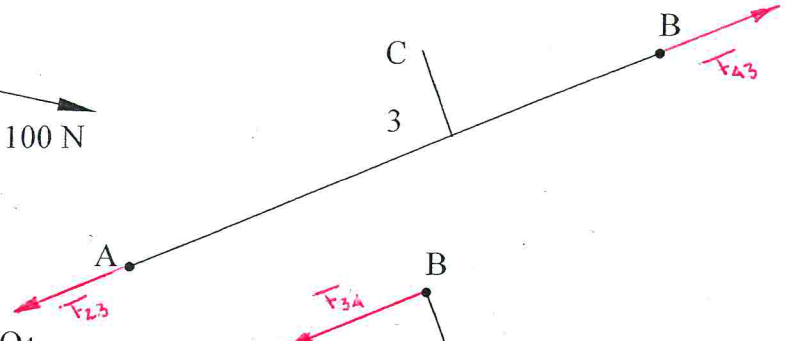
$\tau_{2P} = |F_{32}|d$

$= 100\,(0.035) = 3.5\ \text{Nm}\ \circlearrowright$

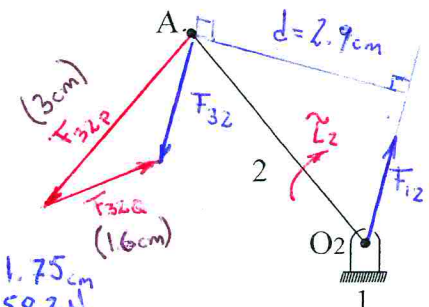


Assume only $\bar{Q}$



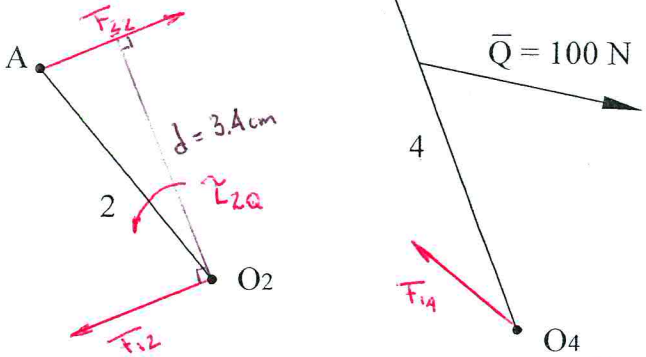


Combine both



$F_{32} = 1.75_{cm} = 58.3\,N$

$\tau_2 = |F_{32}|d = 1.69\,\text{N}\ \circlearrowright$



$\tau_{2Q} = |F_{32}|d = 1.81\,\text{Nm}\ \circlearrowright$

$\tau_2 = \tau_{2P} + \tau_{2Q}$

$= 1.69\ \text{Nm}\ \circlearrowright$