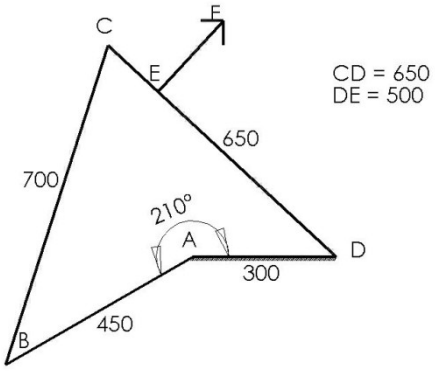
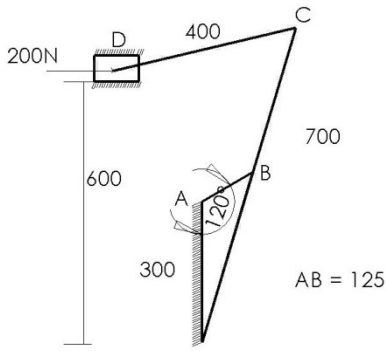
STATIC FORCE ANALYSIS
TUTORIAL I

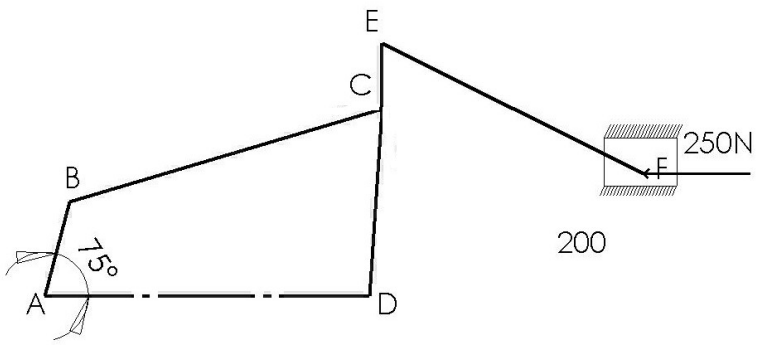
1. Determine the input torque on the crank of a Slider Crank Mechanism for the static equilibrium when the applied piston load is N. The lengths of the crank and the connecting rod are 40mm and 100mm respectively and the crack has turned through 45° from the inner dead centre.(55 N.m)
2. Find the torque required to be applied to link AB of the linkage shown in Fig to maintain the static equilibrium(8.85N.m)



3. Determine the torque required to be applied to link OA of the linkage shown in Fig to maintain the static equilibrium(30.42N.m)



4. For the static equilibrium of the mechanism of the following fig, find the required input torque. The dimensions are as follows
AB=150mm, BC=AD=500mm, DC=300mm, CE=100mm and EF=450mm (45.5N.m CW)



SOLUTIONS

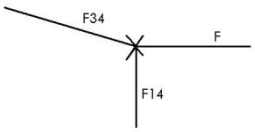
PROBLEM 1

Link 1 = Fixed Link
Link 2 = Crank
Link 3 = Connecting Rod
Link 4 = Slider

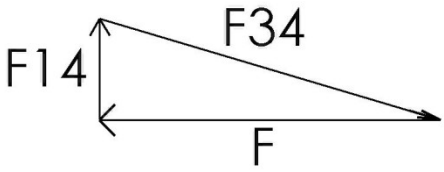
Link 4 acted upon by 3 Forces **F, F_{14}, F_{34}**

(Scale 1mm = 50N)

Free Body Diagram of Link 4

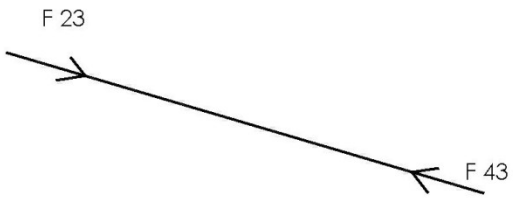


Force Polygon

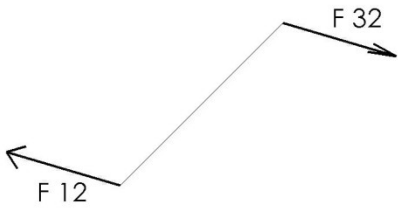


F=1500 N
F34 = 1564 N

Link 3 acted upon by 2 Forces **F_{23},F_{43}**



Link 2 :



h=35mm

From the above relationship
-F34 = F43 = -F23 = F32 = 1564 N

Moment:

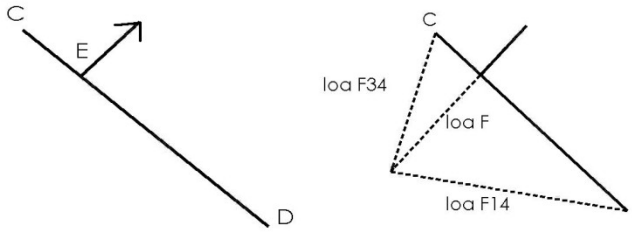
= Force * Horizontal Distance
= 564 * 35
= 54740 N mm
= 54.740 N.m

Therfore the required input Torque is **55 N.m (Anti Clockwise)**

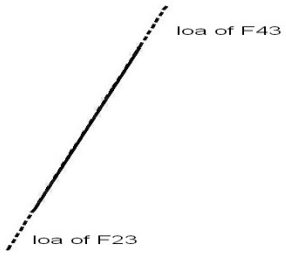
PROBLEM II

Link 1 = Fixed Link
Link 2 =AB
Link 3 = BC
Link 4 = CD

Link 4 Acted ypon by 3 Forces **F, F_{14}, F_{34}**

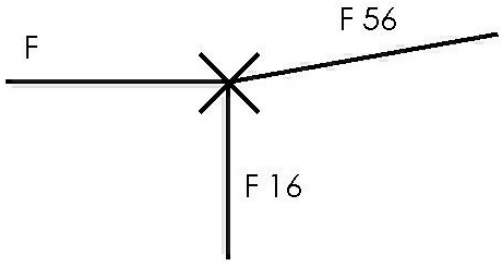


Since the direction and magnitude of other two force were unknown Draw free body diagram of Link 3

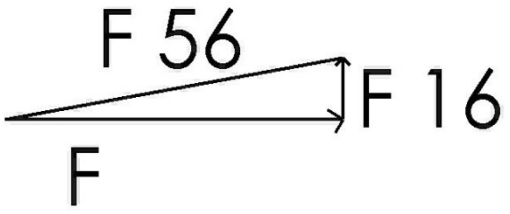


PROBLEM III

Free body diagram of **Link 6**



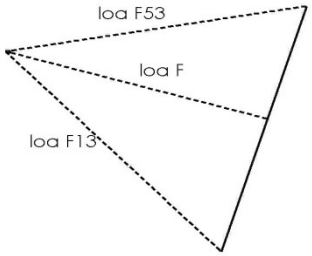
Force Polygon of Slider



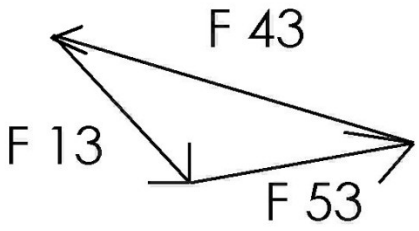
From Force polygon
F 56 = 203N
F16 = 35N

Free body Diagram of **Link 5**

Free body Diagram of **Link 3**



Force Polygon of **Link 3**



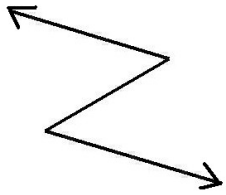
From force polygon

F 53 = 203N

F 43 = 335.7N

F 13 = 179 N

Free Body Diagram of Link 2



H=9.09

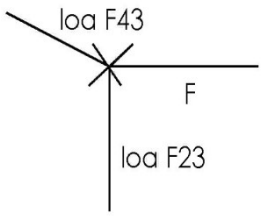
Moment:

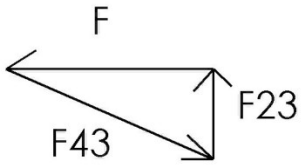
= Force * Horizontal Distance
= 335.7 * 9.09
= 3051.51 N cm
= 30.51 N.m

Required Torque = 30.51N m

PROBLEM IV

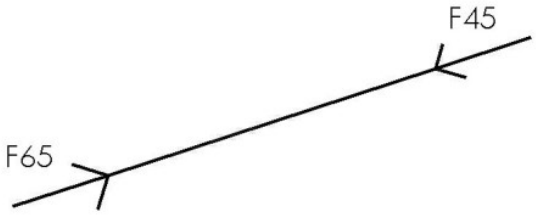
FBD of Link 3 **Force Polygon**





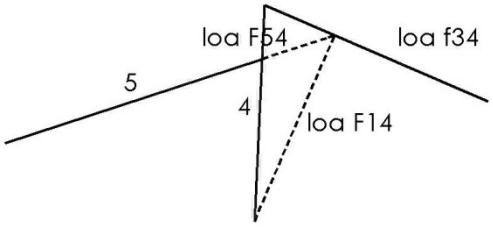
From the above Diagram
F = 250 N
F_{23} = 108N
F_{43} = 272.40N

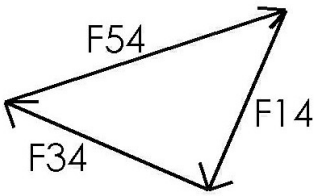
FBD of Link 5



$F_{65}=F_{45}$

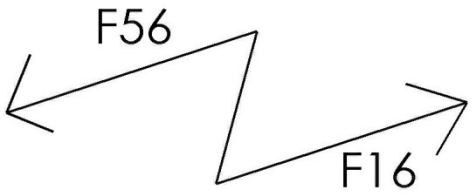
FBD of Link 4 **Force Polygon**





From the above diagram
F_{54} = 363.4N
F_{14} =240.8N

FBD of Link 6



H=12.57mm

Moment:

= Force * Horizontal Distance
= 363.4 * 12.57
= 4567.938
= 45.6 N.m

Required Torque = **45.6 Nm (Clock Wise)**