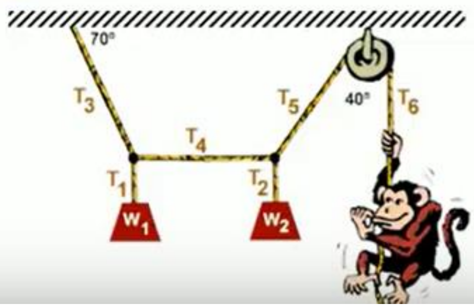
STATIC EQUILIBRIUM

Any body is said to be in static equilibrium, if it posses a state of rest or motion until and unless some external effect acts on it.

i.e.

If a body is at rest it tends to remain at rest and if a body is in motion it tends to remain in the state of motion until and unless an external force is applied on it.



CONDITIONS REQUIRED FOR A BODY TO BE IN STATIC EQUILIBRIUM

The vector sum of all the forces acting on a body is zero, and
The vector sum of all moments about any arbitrary point is zero.
Mathematically,

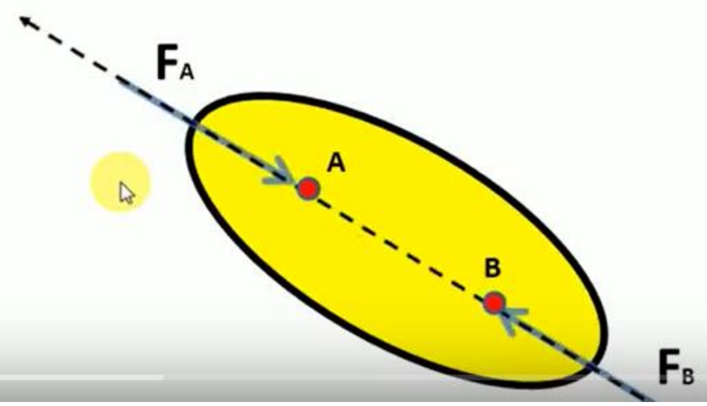
$$\sum F = 0$$
$$\sum T = 0$$

In a planer system, forces can be described by two dimensional vectors and, therefore,

$$\sum Fx = 0$$
$$\sum Fy = 0$$
$$\sum Tz = 0$$

CONDITION OF EQUILIBRIUM OF TWO FORCE MEMBER

- **$|F_A| = |F_B|$ (Same Magnitude)**
- **$F_A = -F_B$ (Opposite in Direction)**
- **And, lies on same line of Action**

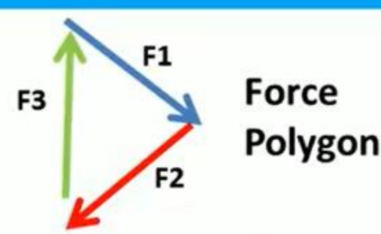


CONDITION OF EQUILIBRIUM OF THREE FORCE MEMBER

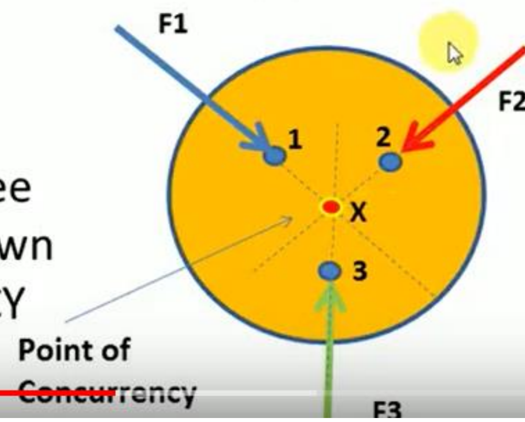
The body with 3 forces will be in static equilibrium when:-

$\sum F = 0 = F1 + F2 + F3 = 0$

I.e. Vector sum of all the 3 forces = 0



Line of action of all the three forces meet at a point, known as POINT OF CONCURRENCY (SAY X, As shown in figure)



CONDITION OF EQUILIBRIUM OF MEMBER WITH TWO FORCES AND A TORQUE

A body with two forces and a torque will be in static Equilibrium when:-

|F1| = |F2| (Forces have same magnitude)

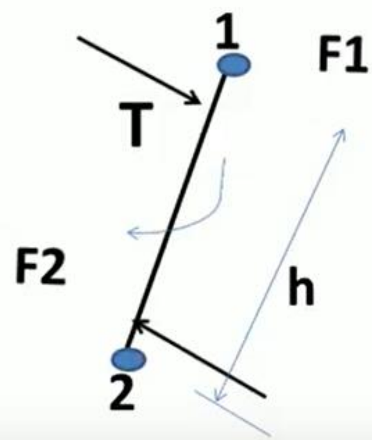
F1 = -F2 (Opposite in directions)

F1 || F2 (Parallel in senses)

And

The combination of forces forms a couple, which is equal and opposite to applied torque.

T = F1 x h = F2 x h

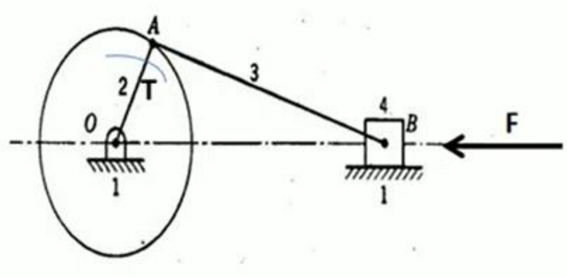


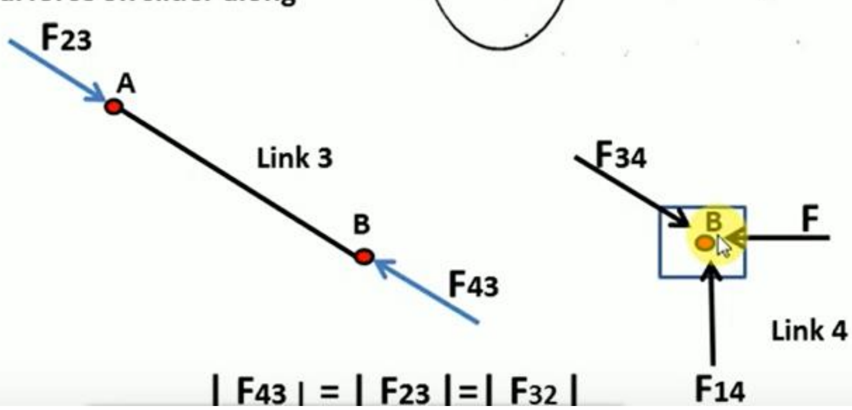
FREE BODY DIAGRAM- SLIDER CRANK MECHANISM

Consider a slider crank mechanism with,

AB as connecting rod (3), OA as crank (2), B as slider (4) and OB as l.o.a of slider.

Let F = External force on slider along l.o.a.





| F43 | = | F23 |=| F32 |