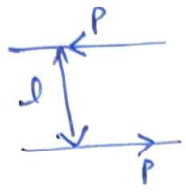
Couple!- Two parallel forces equal in magnitude but opposite in direction, and seperated by a finite distance are said to form a couple.

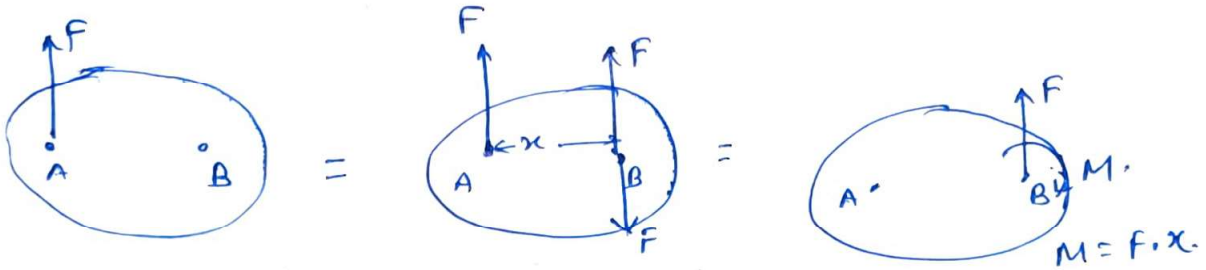


$M = P \times l$.

ex. - opening and closing a water tap.
- locking / unlocking of lock with a key
- Turn of the cap of pen
- Unscrewing the cap of an ink bottle.

* The algebraic sum of the forces forming a couple is zero
* The algebraic sum of the moments

Resolution of a force into a force and couple!-



Force acting at a point in a rigid body can be transferred to an equal and parallel force at any other point in the body, and a couple.

General condition for equilibrium!-

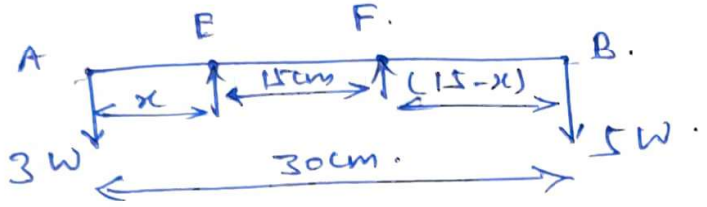
For Coplanar concurrent force system.

Condition for equilibrium - $\Sigma F_x = 0$, $\Sigma F_y = 0$.

For Coplanar non concurrent force system (condition for equilibrium)

$\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M = 0$

Q- A 30 cm long rod rests on two pegs whose distance apart is 15 cm. Weights of 3W and 5W respectively are suspended from its ends. Determine the position of pegs if its reactions are to be equal.



Sol^n

$AE = x$ cm, $BF = (15-x)$ cm.

Reactions at end E & F are equal.

$R_e = R_f = \frac{1}{2}(3W+5W) = 4W$

rod is in equilibrium.

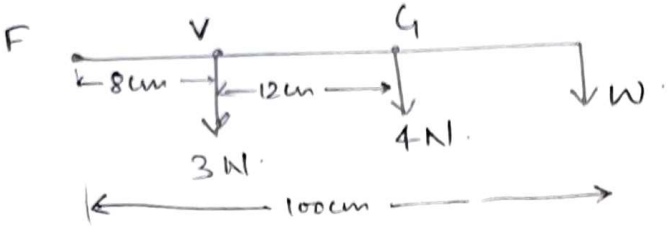
$\Sigma M_e = 0$.

$-3W \times x - 4W \times 15 + 5W(30-x) = 0$

$x = \frac{90}{8} = 11.25$ cm.

$AE = 11.25$ cm, $BF = 15 - 11.25 = 3.75$ cm.

Q. The lever of a lever safety valve is 100 cm long weighs 4 N and this weight acts at its C.G. which is 12 cm away from the valve. The valve weighs 3 N, is 10 cm in diameter and is located at a distance of 8 cm from the fulcrum. Make calculation for the weight to be suspended at the end of the lever which will just release the steam at pressure of 1×10^5 N/m^2



F → fulcrum
V → valve
G - position of C.G.

Sol^n

Force on the valve

P = steam pressure x area of valve

$= 10^5 \times \left(\frac{\pi}{4} \times (.1)^2\right) = 785$ N.

taking moment about fulcrum -

$W \times 100 + 4 \times 20 + 3 \times 8 - 785 \times 8 = 0$

$= 6176$

$W = 61.76$ N.