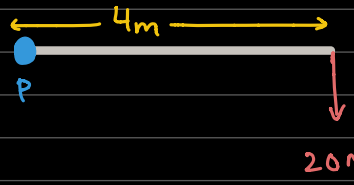
"Turning effect of a force also called moment of a force"

Definition:
Product of forces and the perpendicular distance between the forces and the pivot.

Ex 1.

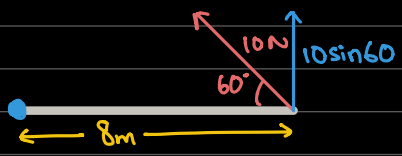


Moment = F x d
= 4 x 20
= 80N

Ex 2

Moment = 0N
because perpendicular distance is 0.

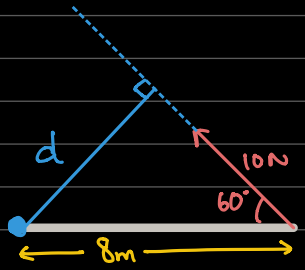
Ex 3



Method 1: Resolve the force and calculate moment with the component perpendicular to the distance from the pivot.

Moment : F x d
= 10 sin 60 x 8
= 80 sin 60
= 69 Nm

Method 2: Extend the line of action of the force and calculate shortest distance between the extended line and the pivot.



$\sin 60 = \frac{d}{8}$

$8 \sin 60 = d$

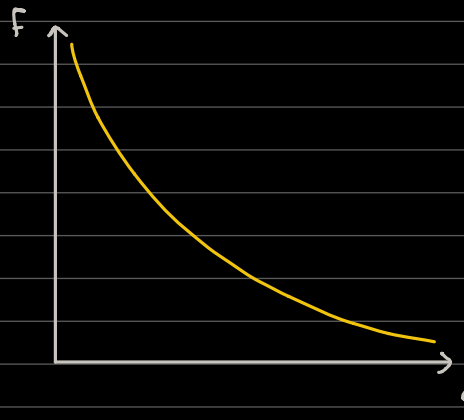
Moment = F x d
= 10 x 8 sin 60
= 80 sin 60
= 69 Nm

What are the conditions of equilibrium?

1. Turning effect must be 0, that is, clockwise moments must equal upwards force

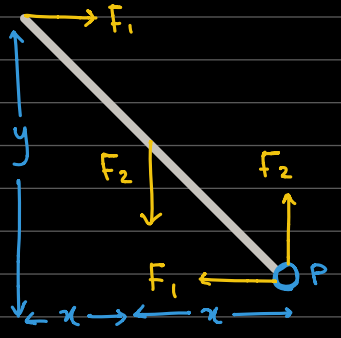
2. Resultant force must also be 0.

Graph of F vs. d, keeping moment constant



$F \propto \frac{1}{d}$ (inversely proportional)

Q.



Apply principle of moments taking P as a pivot to form an equation given that the rod is in equilibrium.

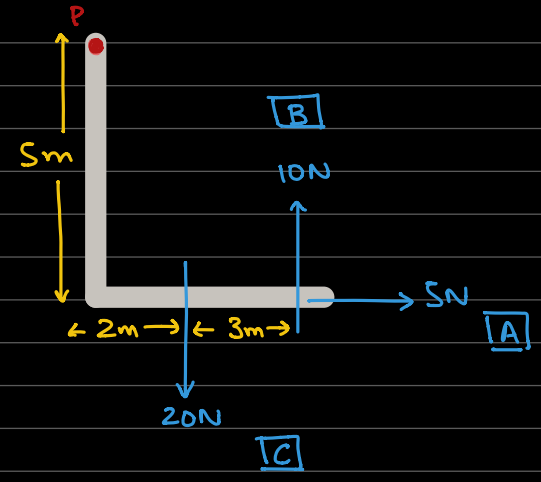
CWM = $F_1 \times y$
CCWM = $F_x \times x$

Final equation ⇒ $(F_1)(y) = (F_2)(x)$

How to find the resultant moments?

- Concept of resultant moments will only arise if one turning effect, either clockwise or counter clockwise, is greater / lesser than the other turning effect.

Example:



Calculate the resultant turning effect.

A. ACW = 5 × 5 = 25 Nm
B. ACW = 10 × 5 = 50 Nm
C CW = 20 × 2 = 40 Nm

ACW CW
[25 + 50] - [40] = Resultant

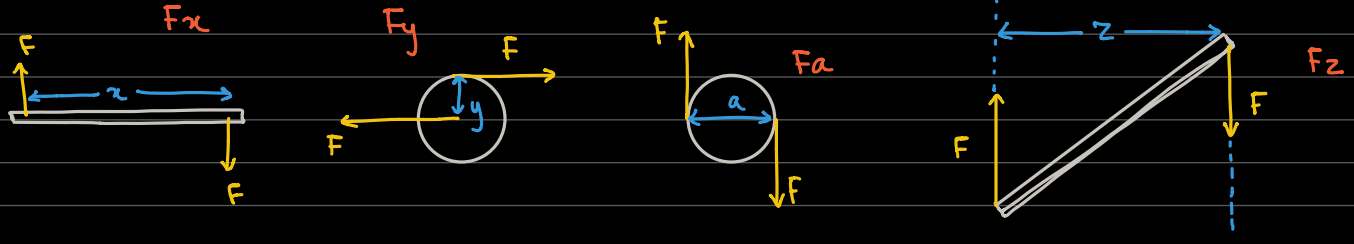
75 - 40 = 35 ACW

∴, the resultant turning effect is 35 Nm anticlockwise

Concept of turning effect of a "couple" also called torque of a "couple":

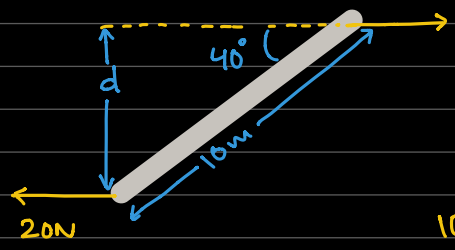
Couple : refers to two equal and anti-parallel (having opposite directions) forces acting on the object at different points.

Example:



Torque of a couple : Any one force multiplied by the perpendicular distance between the two forces.

Example:



$\sin 40 = \frac{d}{10}$

$10 \sin 40 = d$