Torque

Tore-k (not twerk)

Torque

- The ability of a force to rotate an object around an axis. . .a force that causes rotation.
- The force must act **perpendicularly** to the object in order to cause the rotation

$$\tau = F \times r$$

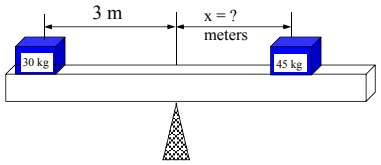
τ = Torque (Nm)
F = Force (N)
r = Distance from the applied force to the axis of rotation (m)

Static Equilibrium

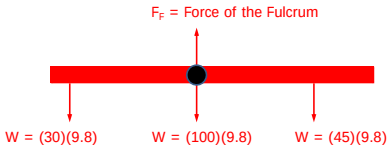
- A condition where objects are neither accelerating nor rotating.
- $\Sigma F_x = 0 \quad \Sigma F_y = 0 \quad \Sigma\tau = 0$
- **Sign Convention**

Sample

Two children are sitting on a see saw as shown in the picture. The see saw has a mass of 100 kg and is supported directly in the middle by a fulcrum. How much force must the fulcrum provide to support the see saw and the children? How far from the fulcrum should the 45 kg child sit in order to balance the see saw?

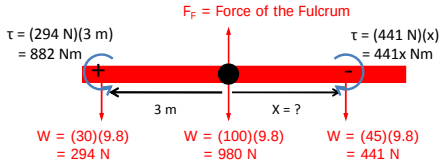


DRAW A FREE BODY DIAGRAM!!!!
(it helps to have it elongated and to place the forces in their approximate locations)



PICK A LOGICAL PLACE FOR THE AXIS OF ROTATION AND DRAW IT INTO THE FBD
(in this case it would be at the fulcrum)

WRITE NET FORCE AND NET TORQUE EQUATIONS AND SOLVE



ΣF_y : $F_{FUL} - 294\text{ N} - 980\text{ N} - 441\text{ N} = 0$

$F_{FUL} = 294\text{ N} + 980\text{ N} + 441\text{ N}$

$F_{FUL} = 1715\text{ N}$

DETERMINE THE DISTANCES FROM THE FORCES TO THE HINGE (axis of rotation)

$\Sigma\tau$: $882 - 441x = 0$

$441x = 882$

$x = 2$ meters

STEPS FOR SOLVING TORQUE PROBLEMS

DRAW FBD

WRITE NET FORCE EQUATIONS

PICK LOGICAL HINGE

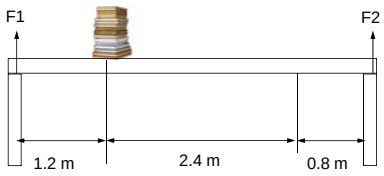
DETERMINE DISTANCES

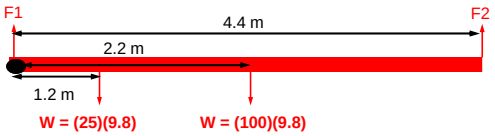
WRITE NET TORQUE EQUATIONS

SOLVE

Sample

- Determine F1 and F2 for the picture of the table below. The table top has a mass of 100 kg and the books have a mass of 25 kg.





ΣF_y : F1 + F2 - (25*9.8) - (100*9.8) = 0

$\Sigma\tau$: -(25*9.8)(1.2) - (100*9.8)(2.2) + (F2)(4.4) = 0

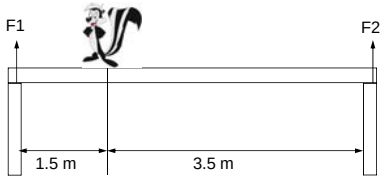
F2 = 556.82 N

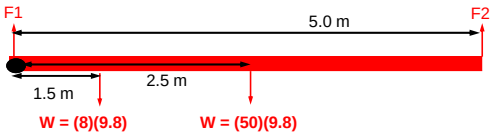
F1 + 556.82 - (25*9.8) - (100*9.8) = 0

F1 = 668.18 N

Practice

- Determine F1 and F2 for the picture of the table below. The table top has a mass of 50 kg and Pepe' Le Pew has a mass of 8 kg.





ΣF_y : F1 + F2 - (8*9.8) - (50*9.8) = 0

$\Sigma\tau$: -(8*9.8)(1.5) - (50*9.8)(2.5) + (F2)(5.0) = 0

F2 = 268.52 N

F1 + 268.52 - (8*9.8) - (50*9.8) = 0

F1 = 299.88 N

Lab 9.1