2nd Newton's Law for Rotation

Linear motion	Rotation	$\omega = \frac{d\theta}{dt}$
Coordinate: x	Angle (in radians): $\theta = l/R$	
Velocity: $v = \Delta x / \Delta t$	Angular velocity: $\omega = \Delta \theta / \Delta t$	dθ
Mass: m	Moment of Inertia: $I = \sum_i m_i r_i^2$	
Acceleration: $a = \Delta v / \Delta t$	Angular acceleration: $\Delta \omega / \Delta t$	
Force, F	Torque, $T = F \times l$	т с
2 nd Newton's Law:	2 nd Newton's Law (for rotation):	\sim
$F = ma = \frac{\Delta(mv)}{\Delta t}$	$T = \frac{\Delta(I\omega)}{\Delta t}$	
p = mv is Linear Momentum		
$L = I\omega$ is called Angular Momentum		
	Тог	rque T = F (Force) \times L (Length)



Condition of mechanical equilibrium:

What is torque?

- Sum of all **forces** acting on an object is zero.
- Sum of all **torques** acting on an object is zero.

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Torque = Force x Lever Arm
                                                      Wrench length
                                                      20 cm
                                       Same force,
                                                                          Force
                                       less torque.
                                                                           120 N
       Torque = (120 N)(0.2m)
                                                               lever
              = 24 N m
                                                                           Torque
                                                               arm
                                                                           18 Nm
                                                            15 cm
                                       Same force.
                                                         Wrench length
                                       no torque!!
                                                                         Zero torque
                                                         20 cm
                                Force
      20 cm = lever arm
                                                                              Force
                                 120 N
                                                                               20 N
                                             Direction of 120 N force passes
                                             through axis, so the lever arm is zero.
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Three examples of torque exerted on a wrench of length 20 cm.

Hometorque

Problem 1 Estimate how much torque you apply to a typical bathroom faucet handle when you shut off the water.

Problem 2 In the picture below, the donkey weights 150 kg. Use the picture to estimate the minimum mass of the load on the cart. Show all the forces, and do appropriate calculation.

