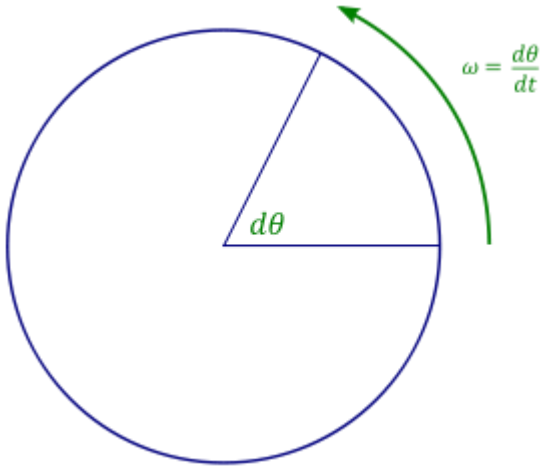
2nd Newton's Law for Rotation

Linear motion	Rotation
Coordinate: x	Angle (in radians): $\theta = l/R$
Velocity: $v = \Delta x/\Delta t$	Angular velocity: $\omega = \Delta\theta/\Delta t$
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, $T = F \times l$



2nd Newton's Law:

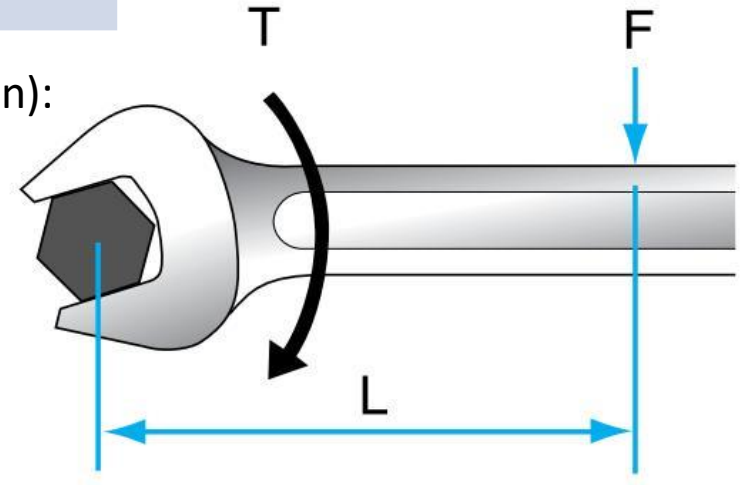
$$F = ma = \frac{\Delta(mv)}{\Delta t}$$

2nd Newton's Law (for rotation):

$$T = \frac{\Delta(I\omega)}{\Delta t}$$

$p = mv$ is Linear Momentum

$L = I\omega$ is called Angular Momentum



Torque T = F (Force) × L (Length)

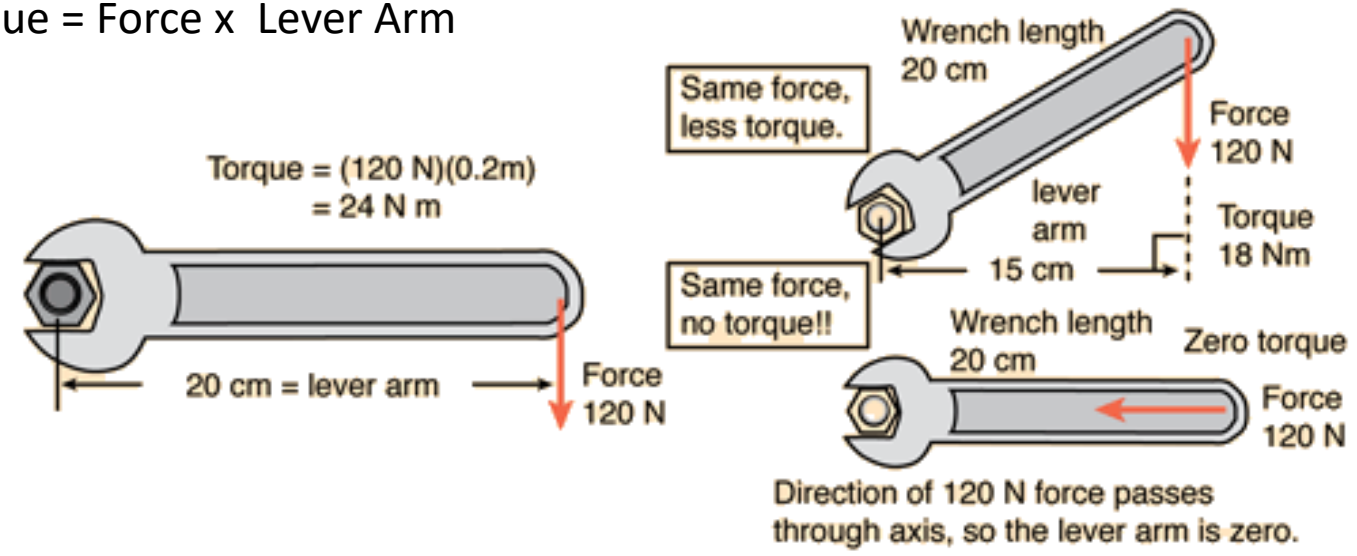
Statics

Condition of mechanical equilibrium:

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

What is torque?

Torque = Force x Lever Arm



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.