Angular Kinetics

Parameters

- **Torque**
  - Definition
  - Units
- **Couple**
- **Center of Gravity (Mass)**
- **Moment of Inertia**
  - Steiner's Theorem or Parallel Axis Theorem
- **Angular Momentum (*H*)**

Newton's First Angular Law
The Law of Inertia

In the absence of an external torque exerted about a given axis, the angular momentum of a body about that axis remains constant.

Law of Inertia may be viewed as a special case of the 2nd Law.

Newton's Second Angular Law
The Law of Acceleration

The rate of change of angular momentum (*H*) of a body [d(*H*)/dt] is proportional to the net torque causing it and the change takes place in the direction the net torque acts.

$T_{NET} \equiv \Sigma T$ – Is the sum of all external torque acting upon the body

$$T_{NET} = d(H)/dt = d(I\omega)/dt = I\, d\omega/dt + dI/dt\, \omega$$

If the body is rigid, (dI/dt = 0) &

$$T_{NET} = d(H)/dt = I\, d\omega/dt + dI/dt\, \omega = I\, d\omega/dt = I\alpha$$

Newton's Second Angular Law
The Law of Acceleration

If an object has constant moment of inertia, we can state this Law as:

The angular acceleration of a body with constant moment of inertiais proportional to the net torque causing it and the change takes place in the direction the net torque acts.

$$T_{NET} = \mathrm{I}\alpha$$

$$\alpha = T_{NET} / \mathrm{I}$$

Newton's Second Angular Law
The Law of Acceleration

$$T_{NET} = d(H)/dt$$

$$T_{NET}\, dt = d(H)$$

$$\int_{t_1}^{t_2} T_{NET}\, dt = \int_{H_1}^{H_2} dH$$

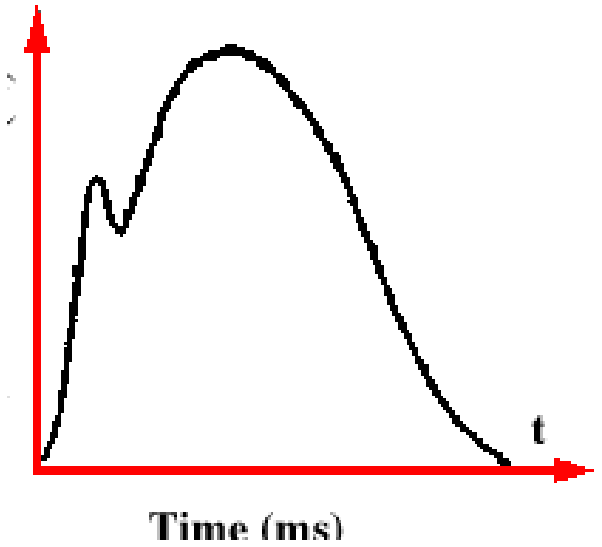
Angular Impulse = Change in Angular Momentum

Newton's Second Law
The Law of Acceleration

Angular Impulse = Change in Angular Momentum

$$\int_{t_1}^{t_2} T_{NET}\, dt = \int_{H_1}^{H_2} dH = (H_2 - H_1) = \Delta H_{1-2}$$

Area under the T_{NET} versus time graph between t_1 and t_2



Newton's Third Law
Action & Reaction

When a body exerts a torque about a given axis, the second body exerts on the first body an equal and opposite torque about the same axis.

In other words, if object A exerts a torque on object B, then object B also exerts an equal and opposite torque on object A.