Acceleration

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Linear Acceleration

Acceleration is a vector that has both magnitude and direction. The average acceleration is the change in velocity over the elapsed time. The SI unit for average velocity is **meter per second squared (m/s²)**.

<math:s>\bar{a}=\frac{\Delta v}{\Delta t}<math:e>

Average acceleration does not provide the acceleration at any instant of time, but rather the average acceleration of the whole trip. The instantaneous acceleration, on the other hand, provides the object's acceleration at a particular time.

Instantaneous acceleration can be obtained when the elapsed time is infinitesimally small. Then, during this very small interval, the instantaneous acceleration is approximately equal to the average acceleration. Thus, the following equation is used to find the instantaneous acceleration of an object:

<math:s>a=\lim_{\Delta t\to0}\frac{\Delta v}{\Delta t}<math:e>

When acceleration changes with respect to time, then jerk is involved.

Angular Acceleration

Angular acceleration is very similar to linear acceleration. When a rigid object is rotating with changing acceleration about an axis of rotation, the object has angular acceleration. The direction of angular acceleration points along the axis of rotation. Moreover, the direction (either upward or downward) of angular acceleration is the same as the direction of the change in angular velocity (If final minus initial angular velocity is positive, then the angular acceleration is the same direction as that of angular velocity; if it is negative, then the angular acceleration is in the opposite direction as that of angular velocity).

The average angular acceleration is the angular velocity over the elapsed time. The SI unit for angular acceleration is **radian per second squared (rad/s²)**.

<math:s>\bar\alpha=\frac{\Delta\omega}{\Delta t}<math:e>

Using the same concept found above, the instantaneous angular acceleration happens when there is a small time interval, and the average angular acceleration is approximately equal to the instantaneous angular acceleration.

<math:s>\alpha=\lim_{\Delta t\to0}\frac{\Delta\omega}{\Delta t}<math:e>

As the tangential velocity of a rigid object (rotating in a circle) changes, there is tangential acceleration. Centripetal acceleration is also involved when a rigid object rotates in circular motion.

Linear acceleration can be related to angular acceleration (ÃŽÂ± must be in rad/s²) in rolling motion, where an object does not slip against the surface of which it is rolling, with the following formula,

<math:s>a=r\alpha<math:e>

Because tangential acceleration is also equal to *r* times ÃŽÂ±, linear acceleration is equal to the tangential acceleration of an object in any rolling motion.