**Circular Motion**

1. **Terms and Symbols:**
2. **Radius(r)** = Distance from the center of circular motion.
3. **Change in Time (Δt)** = Change in time.
4. **Arc length (s)**  = Distance measured along the circumference of a circle.
5. **Angle (θ)** = Angle of rotation measured in Radians (rad)
6. **Radian(rad)** = An angle whose arc length (s) is equal to its radius (r). It is approximately 57.3˚

 **θrad = s**

 **r**

* 1 complete circle has 2π radians.
1. **Circumference (c)** = Distance around the outside track of a circle.

$$c=2πr$$

1. **Angular Speed (ώavg)**  **and Angular Acceleration (αavg)**
* Must use radians (rad)

 **θrad = π x θdeg**

 **180˚**

1. **Angular Displacement (Δθ)** -Describes how much an object has

rotated.

 **Δθ = θf – θi**

 **Δθ = Δs**

 **r**

 **Units**: **Radians(rad)**

* Positive for counterclockwise rotation
* Negative for clockwise rotation
1. **Angular Speed (ώavg)** - Describes rate of rotation: (Greek letter Omega)

 **ώavg = Δ θ = θf – θi**

 **Δ t tf - ti**

 **Units**: **rad/s**

* sometimes measured in rpm 1rev=2πrad
1. **Angular Acceleration(αavg) -**occurs when angular speed(ώavg)

 changes.

 **αavg = ώf – ώi = Δώ**

 **tf – ti Δt**

 **Units: rad/s2**

1. **Relationship between angular and linear variables**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Linear | Angular | Relationship |
| Displacement | x (m) | θ (rad) | s=θr |
| Velocity | v (m/s) | ώ (rad/s) | vt=ώr |
| Acceleration | a (m/s2) | α (rad/s2) | at=αr |

1. **Rotational and Linear Kinematics Equations**

|  |  |
| --- | --- |
| Rotational motion  | Linear motion  |
| ώf = ώi + αt | **vf = vi + at** |
| Δθ = ώit + 1/2αt2 | **Δx = vit + 1/2 at2** |
| ώf2 = ώi2 + 2αΔθ | **vf2= vi2 + 2aΔx** |
|  |  |

1. **Linear Speed and Linear Acceleration**
2. **Tangential Speed (Vt)** – The instantaneous linear speed of an

 object directed along the tangent to the

 object’s circular path.

 **Vt = rώ**

 **Units**: m/s

* ώ must be in rad not rpm
1. **Tangential acceleration (at)** –The instantaneous linear

acceleration of an object directed

 along the tangent to the object’s

 circular path.

 **at = rα**

 **Units**: m/s2

1. **Centripetal Acceleration (ac)** – Acceleration directed toward the

 center of a circular path.

 **ac = vt2**

**r**

 **ac = rώ2**

**Units**: m/s2

* Tangential and centripetal accelerations are perpendicular to each other. The total acceleration is given by the Pythagorean Theorem.

  **atotal2 = at2 + ac2**

The force that maintains circular motion is Fc and counteracts the inertia of the object in circular motion wanting it to follow a straight line. The force is directed toward the venter of rotation.

 **Fc = mvt2**

**r**

 **Fc = mac**

 **Fc = mrώ2**

**Units**: Newtons