ANGULAR KINEMATICS

Angular kinematics studies rotation, without getting into its causes. So it deals with angles and with changes in angles.

Linear kinematics – basic unit:

- meter

Angular kinematics – basic units:

- degree
- revolution
- radian

Definition of a radian:

1 revolution = 360°
1 revolution = 2\pi \text{ radians} = 6.28 \text{ radians}

So:

\[ 1 \text{ radian} = \frac{360}{6.28} = 57.3° \]
Parallelism between linear kinematics and angular kinematics:

<table>
<thead>
<tr>
<th>Linear kinematics</th>
<th>Angular kinematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>linear location (or position)</td>
<td>angular location (or position)</td>
</tr>
<tr>
<td>units: m</td>
<td>units: degrees (or radians)</td>
</tr>
<tr>
<td>linear velocity = ( \frac{\Delta \text{linear location}}{\Delta \text{time}} )</td>
<td>angular velocity = ( \frac{\Delta \text{angular location}}{\Delta \text{time}} )</td>
</tr>
<tr>
<td>units: m/s</td>
<td>units: degrees/s (or radians/s)</td>
</tr>
<tr>
<td>linear acceleration = ( \frac{\Delta \text{linear velocity}}{\Delta \text{time}} )</td>
<td>angular acceleration = ( \frac{\Delta \text{angular velocity}}{\Delta \text{time}} )</td>
</tr>
<tr>
<td>units: m/s²</td>
<td>units: degrees/s² (or radians/s²)</td>
</tr>
</tbody>
</table>
Symbols:

<table>
<thead>
<tr>
<th>Linear kinematics</th>
<th>Angular kinematics</th>
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</thead>
<tbody>
<tr>
<td>linear location (or position): S</td>
<td>angular location (or position): θ (“theta”)</td>
</tr>
<tr>
<td>linear velocity: v</td>
<td>angular velocity: ω (“omega”)</td>
</tr>
<tr>
<td>linear acceleration: a</td>
<td>angular acceleration: α (“alpha”)</td>
</tr>
</tbody>
</table>
Right hand rule (or screwdriver rule)

the fingers follow the direction of the rotation

the thumb indicates the direction of the angular velocity vector
Relationship between angular velocity and linear velocity

Body changes orientation, so it **rotates**.

Individual body parts change orientations, so they also **rotate**.

Each individual body point **rotates**, but we can also say that it **translates** (with curvilinear translation).

So a point on the toe (for example) has both angular velocity and linear velocity.

For a point on the toe: \( v = \omega \cdot r \)

For this formula to work, we need:

- \( \omega \) expressed in radians/s
- \( r \) expressed in meters
- \( v \) comes out in meters/s