## Circular Motion Key Points

<table>
<thead>
<tr>
<th>Angular Speed</th>
<th>Measured in:</th>
<th>Conversions:</th>
<th>Link to time period:</th>
<th>Link to angular speed:</th>
<th>Link to speed:</th>
<th>Link to acceleration:</th>
<th>Link to angular speed:</th>
<th>Link to speed:</th>
<th>Link to acceleration:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity</td>
<td>Measured in:</td>
<td>Link to angular speed:</td>
<td>Direction:</td>
<td>Magnitude:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Constant Speed

- Two ways to get information:
  1) 
  2) 

- To find radial acceleration:

- To find overall acceleration:

  Example: Centripetal force provided by:

### Variable Speed

- Two ways to get information:
  1) 
  2) 

- To find radial acceleration:

- To find overall acceleration:

  Type of circular motion: Special conditions for motion:
## Circular Motion Key Points

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<tr>
<th>Angular Speed</th>
<th>Velocity</th>
<th>Acceleration</th>
<th>Force</th>
</tr>
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<tr>
<td>Measured in:</td>
<td>Measured in:</td>
<td>Link to angular speed:</td>
<td>Link to acceleration:</td>
</tr>
<tr>
<td>$\text{rad } s^{-1}$</td>
<td>$ms^{-1}$</td>
<td>$a = r\omega^2$</td>
<td>$F = ma$</td>
</tr>
<tr>
<td>Conversions:</td>
<td>Link to angular speed:</td>
<td>Link to speed:</td>
<td>Link to speed:</td>
</tr>
<tr>
<td>$\frac{2\pi}{60} \text{ rad } s^{-1} = 1 \text{ rpm}$</td>
<td>$\nu = r\omega$</td>
<td>$a = \frac{\nu^2}{r}$</td>
<td>$F = \frac{mv^2}{r}$</td>
</tr>
<tr>
<td>Link to time period:</td>
<td>Direction:</td>
<td>Direction:</td>
<td>Direction:</td>
</tr>
<tr>
<td>$\omega = \frac{2\pi}{T}$</td>
<td>$\text{Tangential}$</td>
<td>$\text{Radial (&amp; possibly tangential: see below)}$</td>
<td>$\text{Radial (&amp; possibly tangential: see below)}$</td>
</tr>
<tr>
<td>Magnitude:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\text{Depends on nature of circular motion (see below)}$</td>
<td></td>
<td></td>
</tr>
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</table>

## Constant Speed

Two ways to get information:
1) **Resolve perpendicular to motion (usually vertically)**

2) **Resolve radially (this gives centripetal force)**

To find radial acceleration: **Resolve radially and use** $F = ma$

(Recall that $a = \frac{\nu^2}{r} = r\omega^2$)

To find overall acceleration: **Equal to radial acceleration** since tangential component is zero for constant speed. Direction is therefore always towards the centre.

Example:
- Centripetal force provided by:
  - Banked curve Friction between tyres and road
  - Object on a string Tension in the string
  - Orbiting body Gravitational force

## Variable Speed

Two ways to get information:
1) **Use conservation of energy (usually GPE and KE)**

2) **Resolve radially (this gives centripetal force)**

To find radial acceleration: **Resolve radially and use** $F = ma$

(Recall that $a = \frac{\nu^2}{r} = r\omega^2$)

To find overall acceleration: **Resolve tangentially and use** $F = ma$, then use Pythagoras and $\tan \theta$ to combine these two perpendicular vectors (radial and tangential).

**Type of circular motion:**
- Inner circles (could fall inwards)
- Outer circles (could fall outwards)
- Fixed circles (can’t fall)

**Special conditions for motion:**
- $R \geq 0$ to complete circles ($R$ always points inwards)
- $R \geq 0$ to complete circles ($R$ always points outwards)
- $v > 0$ to complete circles ($R$ can point in or out)