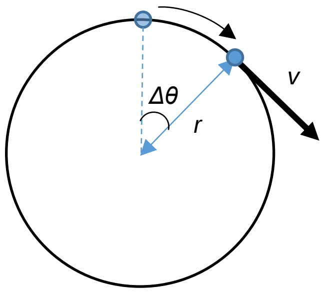
Circular Motion

Uniform Circular Motion



- Direction of v changes
  - By Newton's 2nd law, there is a F_{net}
- No change in v magnitude
  - F_{net} is directed perpendicular to v, towards centre of circle

$$\sum F = F_c = ma$$

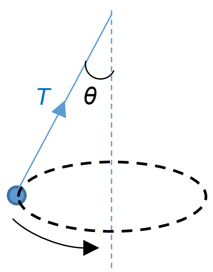
$$F_c = \frac{mv^2}{r}\text{, or}$$

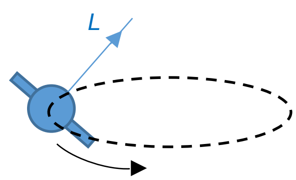
$$F_c = mr\omega^2\text{,}$$

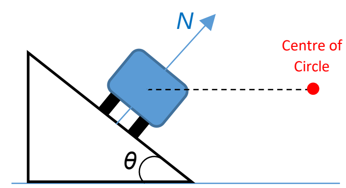
$$v = r\omega\text{,}$$

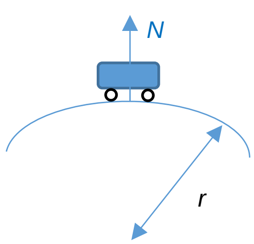
$$\omega = \frac{\Delta\theta}{t} = \frac{2\pi}{T} = 2\pi f$$

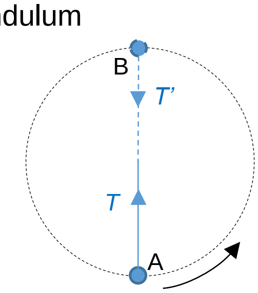
Examples of Circular Motions

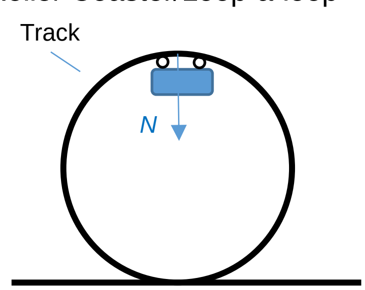
<table>
<tr>
<td>Conical


$F_c = T\sin\theta = \frac{mv^2}{r}$
$T\cos\theta = mg$
$\tan\theta = \frac{v^2}{rg}$</td>
<td>Airplane


$F_c = L\sin\theta = \frac{mv^2}{r}$
$L\cos\theta = mg$
$\tan\theta = \frac{v^2}{rg}$</td>
<td>Banked Road


$F_c = N\cos(90^\circ - \theta)$
$F_c = N\sin\theta = \frac{mv^2}{r}$
$N\cos\theta = mg$
$\tan\theta = \frac{v^2}{rg}$</td>
</tr>
<tr>
<td>Car on Hump


$F_c = mg - N = \frac{mv^2}{r}$</td>
<td>Pendulum


At A, $F_c = T - mg = \frac{mv^2}{r}$
At B, $F_c = T' + mg = \frac{mv'^2}{r}$</td>
<td>Roller Coaster/Loop-a-loop


$F_c = N + mg = \frac{mv^2}{r}$</td>
</tr>
<tr>
<td>To find max v, $N \rightarrow 0$</td>
<td>To find min v at B, $T' \rightarrow 0$
To find max v, T max at A</td>
<td>To find min v at top, $N \rightarrow 0$</td>
</tr>
</table>

- See Gravitational Field summary for more examples