Consider a car moving with a linear velocity, $\vec{v}$.

The tangential speed of a point on the outer edge of the tire is equal to the speed of the car over the ground.

$$v = v_T = r\omega$$

Also, the tangential acceleration of a point on the outer edge of the tire is equal to the acceleration of the car over the ground.

$$a = a_T = r\alpha$$
Example 8  An Accelerating Car

Starting from rest, the car accelerates for 20.0 s with a constant linear acceleration of 0.800 m/s$^2$. The radius of the tires is 0.330 m.

What is the angle through which each wheel has rotated?
8.6 Rolling Motion

\[ \alpha = \frac{a}{r} = \frac{0.800 \text{ m/s}^2}{0.330 \text{ m}} = 2.42 \text{ rad/s}^2 \Rightarrow \alpha = -2.42 \text{ rad/s}^2 \]

since the wheels go clockwise

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>( \alpha )</th>
<th>( \omega )</th>
<th>( \omega_o )</th>
<th>( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>-2.42 rad/s(^2)</td>
<td>0 rad/s</td>
<td>20.0 s</td>
<td></td>
</tr>
</tbody>
</table>

\[ \theta = \omega_o t + \frac{1}{2} \alpha t^2 \]

\[ \theta = \frac{1}{2} \left( -2.42 \text{ rad/s}^2 \right) \left( 20.0 \text{ s} \right)^2 = -484 \text{ rad} \]