Answer on Question #48377, Physics, Mechanics | Kinematics | Dynamics

A mustang going from 0 to 60 in 3.5 seconds has an acceleration of 7.7m/s. Radius of the tires is .35m, what is the angular displacement of the tires between the rest time and 60mph. Provide answer in radians and use the revolution of a tire is 2 x pie x r to convert to the linear distance that was traveled. Then also confirm this by using kinematics.

Solution:

Given:

$v = 60 \text{ mph} = 60 * 0.44704 = 26.82 \text{ m/s},$

$t = 3.5 \text{ s},$

$a = 7.7 \text{ m/s}^2,$

$r = 0.35 \text{ m},$

$\theta = ?,$

Angular displacement formula in terms of angular velocity is given by

$$\theta = \omega t$$

Where ω is angular velocity, t is the time taken.

The average angular velocity is defined

$$\omega_{average} = \frac{\omega_0 + \omega_f}{2}$$

Linear speed = radius × angular speed

$$v = r\omega$$

Thus,

$$\omega_{average} = \frac{0 + \frac{v}{r}}{2} = \frac{v}{2r} = \frac{26.82}{2 * 0.35} = 38.31 \frac{\text{rad}}{\text{s}}$$

So,

$$\theta = 38.31 * 3.5 = 134.1 \text{ rad}$$

The linear displacement

$$S = \theta r = 134.1 * 0.35 = 46.9 \approx 47 \text{ m}$$

The angular displacement is the angle through which a body rotates in circular path. It is denoted by θ and expressed in radians

$$\theta = \frac{S}{r}$$

where S is linear displacement.

Kinematics equation

$$S = \frac{v^2 - v_0^2}{2a}$$

where *a* is acceleration, *S* is distance, v_0 is initial velocity and *v* is final velocity.

Thus,

$$S = \frac{26.82^2}{2 * 7.7} = 46.71 \approx 47 \text{ m}$$