Answer Question #65703 – Physics – Mechanics – Relativity

An automobile travelling at 80 km hr-1 has tyres of radius 80 cm. On applying brakes, the car is brought to a stop in 30 complete turns of the tyres. What is the magnitude of the angular acceleration of the wheels? How far does the car move while the brakes are applied?

Solution. Angular movement of the automobile tyres to the stop is equal to $\varphi = 2\pi N$rad, where $N = 30$. Hence the distance traveled by the vehicle to the stop is equal to $d = \varphi R = 2\pi NR = 60\pi R$.

$d = 60\pi \cdot 0.8m \approx 150.8m.$

Find the initial angular velocity using the formula $\omega_i = \frac{v}{R}$, where $v = 80\frac{km}{h}$ – the speed of the car, $R = 0.8m$ – radius of tires. The final angular velocity is zero as the car tyres do not rotate. Find the angular acceleration using the formula $\varphi = \frac{\omega_f^2 - \omega_i^2}{\varepsilon} \to \varepsilon = \frac{\omega_f^2 - \omega_i^2}{\varphi}$, where $\omega_f = 0\frac{rad}{s}$ – final angular velocity, $\omega_i = \frac{80}{3.6 \cdot 0.8} \approx 27.8\frac{rad}{s}$. Hence

$\varepsilon = \frac{27.8^2 - 0^2}{60\pi} \approx 4.1\frac{rad}{s^2}$.

Answer. $\varepsilon = 4.1\frac{rad}{s^2}$, $d = 150.8m.$