An automobile travelling at $v_0 = 80$ km hr-1 has tyres of radius $r = 80$ cm. On applying brakes, the car is brought to a stop in $N = 30$ 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

The car will travel distance

$$L = 2\pi Nr = 2 \times 3.14 \times 30 \times 0.8 = 150.72 \text{ m.}$$

Since the final speed of car is equal to zero

$$v^2 = v_0^2 + 2aL = v_0^2 + 4\pi aNr = 0.$$

So the linear acceleration (deceleration) is

$$a = -\frac{v_0^2}{4\pi Nr}.$$

The angular acceleration

$$\varepsilon = \frac{a}{r} = -\frac{v_0^2}{4\pi Nr^2} = -\frac{(80/3.6)^2}{4 \times 3.14 \times 30 \times 0.8^2} = -2.04 \frac{\text{rad}}{\text{s}^2}.$$

Answer $\varepsilon = -2.04 \frac{\text{rad}}{\text{s}^2}$, $L = 150.72$ m.

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