











1. 🚖 Gravitational Acceleration:

Given:

$$g = 9.81 \text{ m/s}^2$$

- This is the standard Earth gravity.
- Used to calculate **normal force** acting on the tire:

$$F_n = \frac{m \cdot g}{4}$$

(Assuming vehicle load is evenly distributed across 4 wheels)

2. 🧱 Vehicle Mass (Quarter Model):

Assumption:

- Let the **total vehicle mass** $\approx 300 \text{ kg}$
- We use a **single wheel model**, so:

$$m = \frac{300}{4} = 75 \text{ kg}$$

- This simplifies modeling without losing generality for ABS dynamics.

3. Moment of Inertia of the Wheel:

Formula (for a solid disc):

$$I = \frac{1}{2}m_r R^2$$

Where:

- m_r : mass of the wheel (rim + tire)
- R : radius of the wheel

Assume:

- $m_r = 6.4 \text{ kg}$
- $R = 1.25 \text{ m}$

Then:

$$I = \frac{1}{2} \cdot 6.4 \cdot (1.25)^2 = \frac{1}{2} \cdot 6.4 \cdot 1.5625 = 5 \text{ kg} \cdot \text{m}^2$$

✓ So we take:

$$I = 5 \text{ kg} \cdot \text{m}^2$$

4. 🌀 Wheel Radius:

Given:

$$R = 1.25 \text{ m}$$

Why this value?

- Chosen for easier scaling of angular-to-linear conversion:

$$v = \omega \cdot R$$

- A larger radius makes the torque and braking force more observable.

✅ Practical vehicle wheels range between 0.3 – 0.7 m. 1.25 m is exaggerated for simulation clarity.

5. 🚗 Initial Vehicle Speed:

Given:

$$v_0 = 44 \text{ m/s}$$

Conversion:

$$44 \text{ m/s} = 44 \cdot 3.6 = 158.4 \text{ km/h}$$

- Represents a **highway speed** or **emergency braking scenario**.
- Useful to evaluate how ABS maintains stability at **high slip conditions**.

Parameter	Value	How it was Chosen
g	9.81 m/s^2	Standard constant
m	75 kg	1/4 of vehicle mass (300 kg total)
I	$5 \text{ kg} \cdot \text{m}^2$	Solid disc approx. for a 6.4 kg wheel
R	1.25 m	Scaled-up for simulation clarity
v_0	44 m/s	~158.4 km/h highway speed