1. ⚖️ Gravitational Acceleration:

Given:

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

- 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** ≈ 300 kg
- We use a **single wheel model**, so:

$$m = \frac{300}{4} = 75\,\mathrm{kg}$$

- 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:

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

Then:

$$I = \frac{1}{2} \cdot 6.4 \cdot (1.25)^2 = \frac{1}{2} \cdot 6.4 \cdot 1.5625 = 5\,\mathrm{kg}\textbackslash\mathrm{cdotp}\mathrm{m}^2$$

✅ So we take:

$$I = 5\,\mathrm{kg}\textbackslash\mathrm{cdotp}\mathrm{m}^2$$

4. 🔘 Wheel Radius:

Given:

$$R = 1.25\,\mathrm{m}$$

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:

$$v_0 = 44\,\mathrm{m/s}$$

Conversion:

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

- 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/s²	Standard constant
m	75 kg	1/4 of vehicle mass (300 kg total)
I	5 kg·m²	Solid disc approx. for a 6.4 kg wheel
R	1.25 m	Scaled-up for simulation clarity
v0	44 m/s	~158.4 km/h highway speed