Answer on Question #63484, Physics / Mechanics | Relativity

A 1900 kg car moves along a horizontal road at speed v_0 = 11.3 m/s. The road is wet, so the static friction coefficient between the tires and the road is only μ_s = 0.15 and the kinetic friction coefficient is even lower, μ_k = 0.105. The acceleration of gravity is 9.8 m/s^2 . What is the shortest possible stopping distance for the car under such conditions? Use g = 9.8 m/s^2 and neglect the reaction time of the driver. Answer in units of m

Solution:

Stopping is shortest when the wheels don't slide, so we will use μ_s = 0.15.

Second Newton's law for the car:

$$F_{fr} = ma_{max}$$

Formula for the friction force:

$$F_{fr} = \mu_s N = \mu_s mg$$

Hence, the highest possible deceleration of the car is

$$a_{max} = \mu_s g = 0.15 \cdot (9.8 \text{ m/s}^2) = 1.47 \text{ m/s}^2$$

The shortest possible stopping distance for the car under such conditions is

$$d = \frac{v_0^2}{2a_{max}} = \frac{11.3^2}{2 \cdot 1.47} = 43.43 \text{ m}$$

Answer: 43.43 m