A 1600 kg car moves along a horizontal road
at speed v0 = 17.3 m/s. The road is wet,
so the static friction coefficient between the
tires and the road is only μs = 0.311 and
the kinetic friction coefficient is even lower,
μk = 0.2177.
The acceleration of gravity is 9.8 m/s2 . Assume: No aerodynamic forces; g = 9.8 m/s2, forward is the positive direction.
What is the highest possible deceleration of
the car under such conditions?
Answer in units of m/s2

Solution:

$\mathrm{m} = 1600\mathrm{kg} - \text{mass of the car;}$

$\mathrm{V_0} = 17.7\frac{\mathrm{m}}{\mathrm{s}} - \text{speed of the car;}$

$\mathrm{g} = 9.8\frac{\mathrm{m}}{\mathrm{s^2}} - \text{acceleration due to gravity;}$

$\mathrm{a_{max}} - \text{highest possible deceleration of the car}$

$\mu_\mathrm{s} = 0.311 - \text{static friction coefficient between the tires and the road ;}$

$\mu_\mathrm{k} = 0.2177 - \text{kinetic friction coefficient ;}$

Second Newton's law for the car (N - reaction force):

$\mathrm{y}: \mathrm{N} = \mathrm{mg}$

$x: \mathrm{F_{fr}} = m\mathrm{a_{max}} \qquad (1)$

Formula for the friction force:

$\mathrm{F_{fr}} = \mathrm{N}\mu_\mathrm{k} = \mathrm{mg}\mu_\mathrm{k} \qquad (2)$ (we use μ_k because car moves)

$(2)\mathrm{in}(1)$:

$\mathrm{mg}\mu_\mathrm{k} = \mathrm{ma_{max}}$

$\mathrm{a_{max}} = \mathrm{g}\mu_\mathrm{k} = 9.8\frac{\mathrm{m}}{\mathrm{s^2}} \cdot 0.2177 = 2.13\frac{\mathrm{m}}{\mathrm{s^2}}$

Answer: the highest possible deceleration of the car under such conditions is $2.13\frac{\mathrm{m}}{\mathrm{s^2}}$.