Q- A car is traveling at 50.0 mi/hr on a horizontal highway.
(a) If the coefficient of static friction between road and tires on a rainy day is 0.100, what is the minimum distance in which the car will stop?
(b)What is the stopping distance when the surface is dry and Mu sub s = 0.600

1 mile = 1609 m, 1 hr = 3600 s: Gives 1 mi/hr = 1609/3600 m/s = 0.447 m/s

u = 50 mi/hr = 50*0.447 m/s = 22.35 m/s.

If the breaks are pushed hard it makes the wheels stop rotating immediately and the tires starts sliding on the road in place of rolling. Here friction between the tires and the road starts decelerating the car.

Let the mass of the car is m then the normal reaction of the road will be equal to the weight of the car or

$N = mg$

And the friction force on the car will be

$F = - \mu N = - \mu mg$

Hence acceleration of the car when the breaks are applied

$a = F/m = - \mu mg/m = - \mu g$

The distance covered by the car before coming to rest is given by the third equation of motion as

$v^2 = u^2 + 2*a*s$

Where v is the final velocity of the car (=0) and u is the initial velocity of the car

Hence we have

(a) $v^2 = u^2 + 2*a*s$

Or $0 = (22.35)^2 + 2*(-0.100*9.8)*s = 499.523 - 19.6*s$

Gives $s = \frac{499.523}{1.96} = 254.86$ m

(b) $v^2 = u^2 + 2*a*s$

Or $0 = (22.35)^2 + 2*(-0.600*9.8)*s = 499.522 - 11.76*s$

Gives $s = \frac{499.523}{11.76} = 42.48$ m