A car of mass 800 kg is negotiating a turn of radius 20 m on a level road. What is the maximum speed the car is allowed on this curve? The coefficient of static friction between the tires and the road is 0.8.

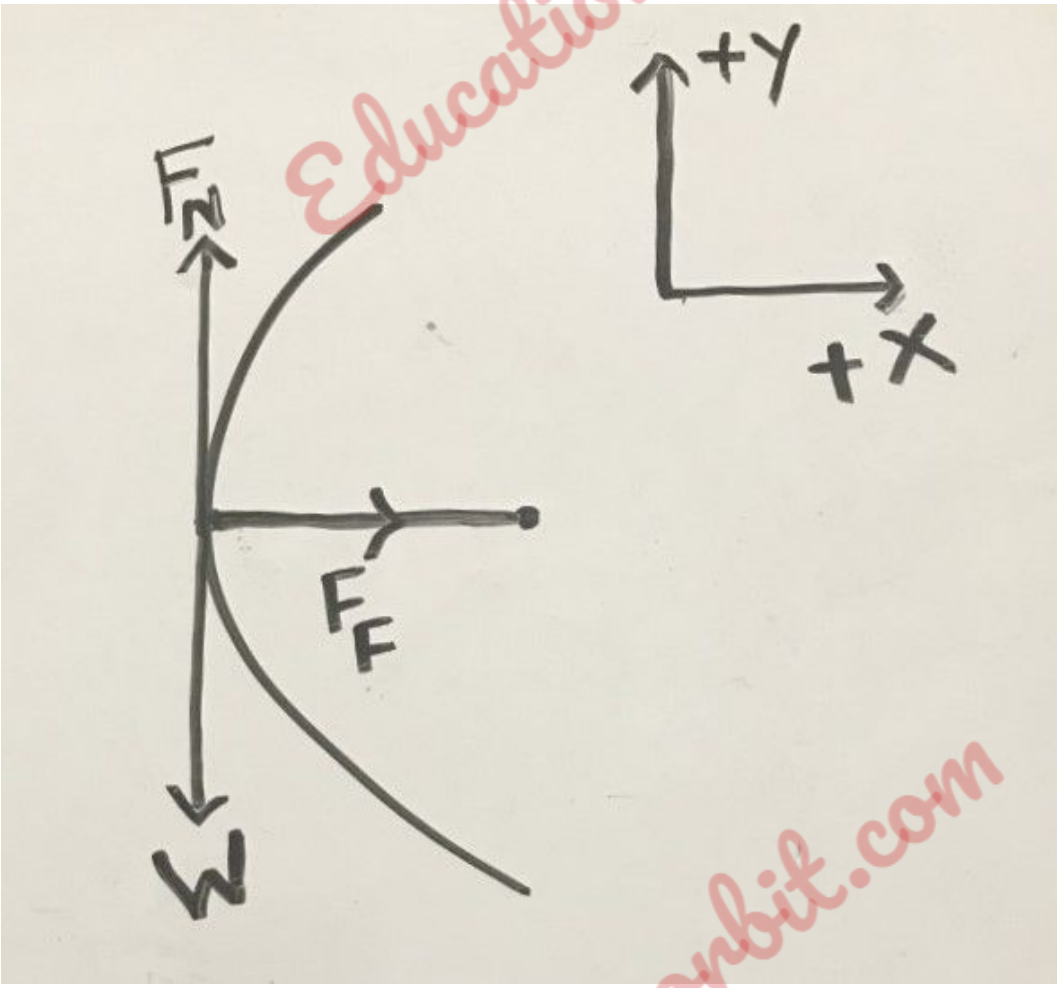

Fig 1

Forces W (weight of the car) and F_N (normal force) act on the car in the plane perpendicular to the plane in which the car is moving. Frictional force between the tires and the road provides the centripetal force required to keep the car on the curved path. Centripetal force is "mv^2 / r" and acts towards the center of the circular path.

Given:

Mass of the car	$m = 800$ kg
Radius of the curve	$r = 20$ m
Coefficient of static friction	$\mu_s = 0.8$
Acceleration due to gravity	$g = -9.8$ m/s^2

Determine:

Maximum speed allowed for the car: v_{max}

Net force in the plane perpendicular to the plane of motion of the car:

$$F_y = F_N - W = 0 \text{ ----------(1)}$$

$$W = mg$$

Then:

$$F_N - mg = 0$$

$$F_N = mg = 800 \times |-9.8| = 7840 \text{ N}$$

Net force in the plane of motion of the car:

$$F_X = ma_x = F_F = \mu_s F_N \text{ ----------(2)}$$

Then from (2):

$$a_x = \mu_s F_N / m \text{ ----------(3)}$$

Also:

$$a_x = (v_{max}^2) / r \text{ ----------(4)}$$

Combining (3) & (4):

$$(v_{max}^2) / r = \mu_s F_N / m \text{ ----------(5)}$$

Rearranging (5) & substituting for m, r, μ_s , & F_N in (5)

$$\mathbf{v_{max} = (\mu_s F_N r / m)^{1/2} = [(0.8 \times 7840 \times 20) / 800]^{1/2} = 12.5 \text{ m/s}}$$