

## Answer on Question #48381, Physics, Mechanics | Kinematics | Dynamics

You are on a circular racetrack that does not have banked turns. The radius of the track's circle is  $2.5 \times 10^2$  m. Starting from rest you accelerate uniformly at a rate of  $4 \text{ m/s}^2$ . The coefficient of friction is .8, how many seconds will it take to start sliding off of the track?

### Solution:

Centripetal acceleration is part of moving in a circular path. Centripetal acceleration points toward the center of the circular path of the car, but is felt by passengers as a force pushing them to the outer edge of the circular path.

The equation for centripetal acceleration is:

$$a_r = \frac{v^2}{r}.$$

The dynamics equation is

$$ma_r = F_{fr}$$

The maximum amount of friction force that a surface can exert upon an object can be calculated using the formula below:

$$F_{frict} = \mu F_{norm} = \mu mg$$

Thus,

$$\begin{aligned} ma_r &= \mu mg \\ a_r &= \mu g \\ \frac{v^2}{r} &= \mu g \end{aligned}$$

The maximum velocity is

$$v = \sqrt{\mu gr} = \sqrt{0.8 * 9.8 * 2500} = 140 \text{ m/s}$$

The time we obtain from kinematics equation:

$$t = \frac{v - v_0}{a} = \frac{140 - 0}{4} = 35 \text{ s}$$

**Answer:**  $t = 35 \text{ s}$