CIRCULAR TURNING ON ROADS

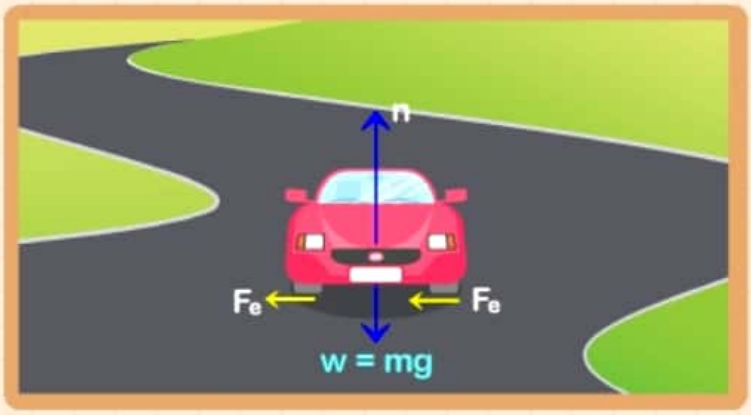
Centripital force required for turning is provided in following ways.

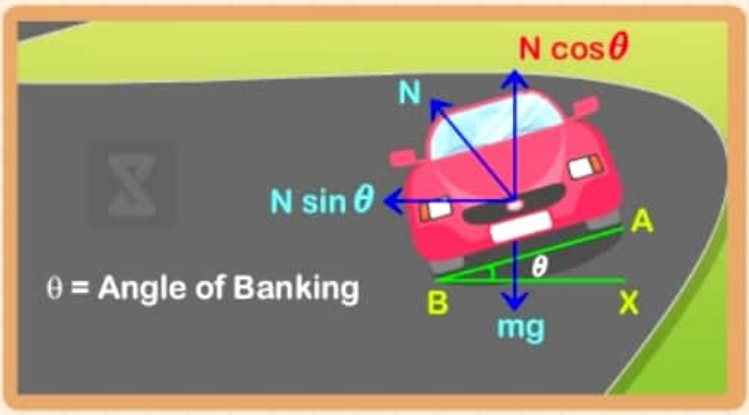
BY FRICTION ONLY

For a safe turn without sliding:

Safe Speed $v \leq \sqrt{\mu rg}$

- The safe speed of the vehicle should be less than $\sqrt{\mu rg}$
- The coefficient of friction should be more than v^2/rg.





BY BANKING OF ROADS ONLY

From FBD of car:

$N\sin\theta = \frac{mv^2}{r}$ & $N\cos\theta = mg$

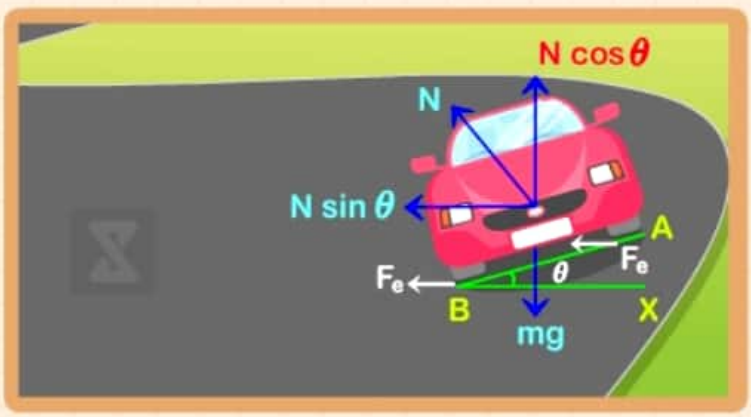
From these two equations, we get

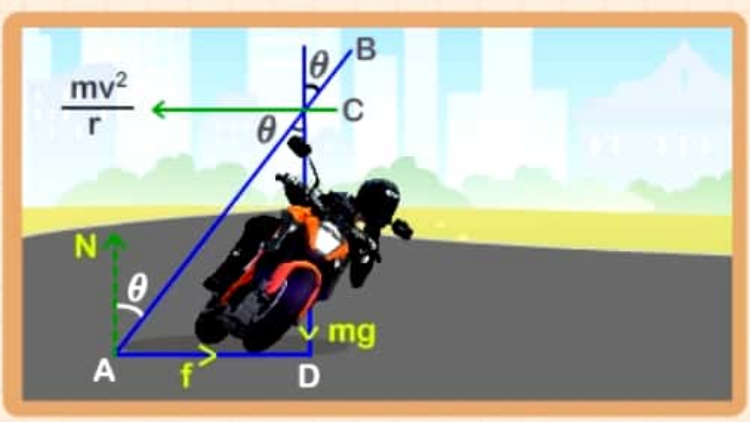
$\tan\theta = \frac{v^2}{rg}$ & $v = \sqrt{rg\tan\theta}$

BOTH FRICTION AND BANKING OF ROADS

Maximum safe speed $v_{max} = \sqrt{\frac{rg(\mu + \tan\theta)}{(1 - \mu\tan\theta)}}$

Minimum safe speed $v_{max} = \sqrt{\frac{rg(\mu - \tan\theta)}{(1 + \mu\tan\theta)}}$





BIKE ON A CIRCULAR PATH

$$\frac{AD}{CD} = \frac{v^2}{rg} \Rightarrow \tan\theta = \frac{v^2}{rg}$$

Thus, the cyclist bends at an angle $\tan^{-1}[v^2/rg]$ with the vertical.