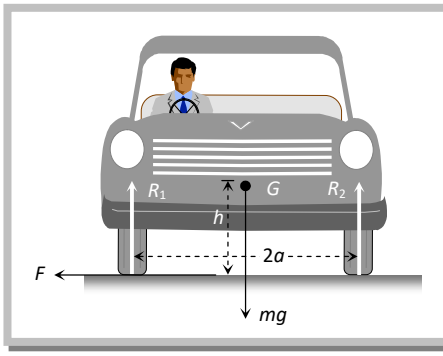
Overturning of Vehicle.

When a car moves in a circular path with speed more than maximum speed then it overturns and it's inner wheel leaves the ground first



Weight of the car = mg

Speed of the car = v

Radius of the circular path = r

Distance between the center of wheels of the car = $2a$

Height of the center of gravity (G) of the car from the road level = h

Reaction on the inner wheel of the car by the ground = R_1

Reaction on the outer wheel of the car by the ground = R_2

When a car move in a circular path, horizontal force F provides the required centripetal force

$$i.e.,\ F = \frac{mv^2}{R} \qquad \text{.....(i)}$$

For rotational equilibrium, by taking the moment of forces R_1, R_2 and F about G

$$Fh + R_1 a = R_2 a \qquad \text{.....(ii)}$$

As there is no vertical motion so $R_1 + R_2 = mg$ .....(iii)

By solving (i), (ii) and (iii)

$$R_1 = \frac{1}{2} M\left[g - \frac{v^2 h}{ra}\right] \qquad \text{.....(iv)}$$

and $$R_2 = \frac{1}{2} M\left[g + \frac{v^2 h}{ra}\right] \qquad \text{.....(v)}$$

It is clear from equation (iv) that if v increases value of R_1 decreases and for $R_1 = 0$

$$\frac{v^2 h}{ra} = g \qquad \text{or} \qquad v = \sqrt{\frac{gra}{h}}$$

i.e. the maximum speed of a car without overturning on a flat road is given by $v = \sqrt{\frac{gra}{h}}$