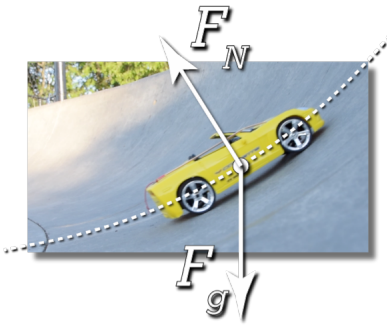
Flipping Physics Lecture Notes:

Determining the Force Normal on a Toy Car moving up a Curved Hill

Example: A 0.453 kg toy car moving at 1.15 m/s is going up a semi-circular hill with a radius of 0.89 m. When the hill makes an angle of 32° with the horizontal, what is the magnitude of the force normal on the car?



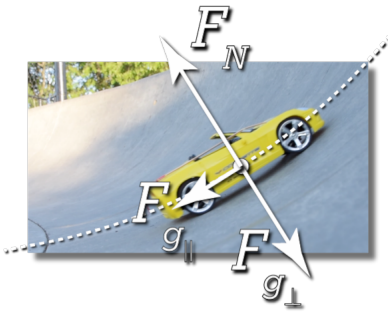
Knowns: $m = 0.453kg;\ \mathbf{v}_t = 1.15\frac{m}{s};\ r = 0.89m;\ \theta = 32°;\ F_N = ?$

Draw FBD:

Break forces into components (in-direction and parallel to in-direction)

$$F_{g_\perp} = mg\cos\theta \ \&\ F_{g_\parallel} = mg\sin\theta$$

Re-draw FBD:



$$\sum F_{in} = F_N - F_{g_\perp} = ma_c \Rightarrow F_N = F_{g_\perp} + ma_c = mg\cos\theta + m\frac{v_t^{\,2}}{r}$$

$$\Rightarrow F_N = (0.453)(9.81)\cos(32) + (0.453)\frac{1.15^2}{0.89} = 4.3804 \approx \boxed{4.4N}$$