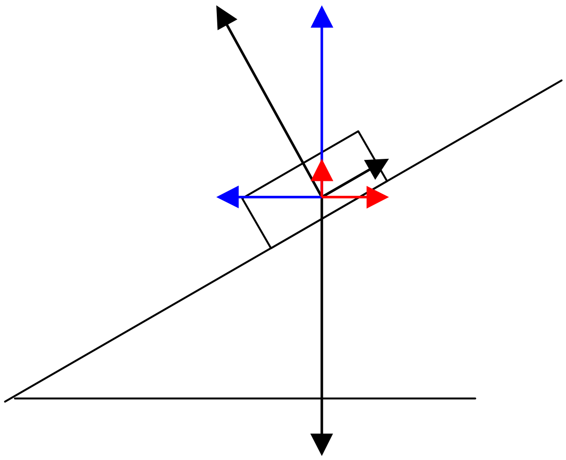

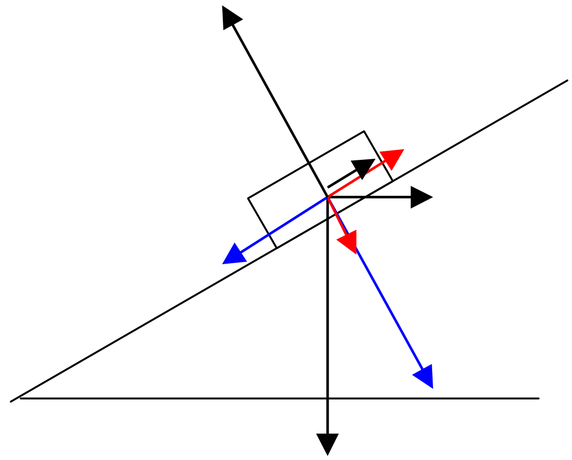

With $\frac{mv^2}{r}$ taken as a centrifugal force, there is no acceleration.

$$mg = N\cos x + F\sin x$$

$$\frac{mv^2}{r} = N\sin x - F\cos x$$

$$(mg)^2 = N^2\cos^2 x + F^2\sin^2 x + 2NF\cos x\sin x$$

$$\left(\frac{mv^2}{r}\right)^2 = N^2\sin^2 x + F^2\cos^2 x - 2NF\cos x\sin x$$

$$(mg)^2 + \left(\frac{mv^2}{r}\right)^2 = N^2 + F^2$$

$$mg\sin x = N\sin x\cos x + F\sin^2 x$$

$$mg\cos x = N\cos^2 x + F\sin x\cos x$$

$$\frac{mv^2}{r}\sin x = N\sin^2 x - F\sin x\cos x$$

$$\frac{mv^2}{r}\cos x = N\sin x\cos x - F\cos^2 x$$

$$mg\sin x - \frac{mv^2}{r}\cos x = F$$

$$mg\cos x + \frac{mv^2}{r}\sin x = N$$

$$N = mg\cos x + \frac{mv^2}{r}\sin x$$

$$F = mg\sin x - \frac{mv^2}{r}\cos x$$

$$N^2 = (mg)^2\cos^2 x + \left(\frac{mv^2}{r}\right)^2\sin^2 x + 2mg\left(\frac{mv^2}{r}\right)\sin x\cos x$$

$$F^2 = (mg)^2\sin^2 x + \left(\frac{mv^2}{r}\right)^2\cos^2 x - 2mg\left(\frac{mv^2}{r}\right)\sin x\cos x$$

$$N^2 + F^2 = (mg)^2 + \left(\frac{mv^2}{r}\right)^2$$