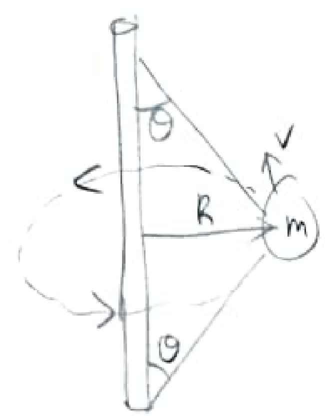
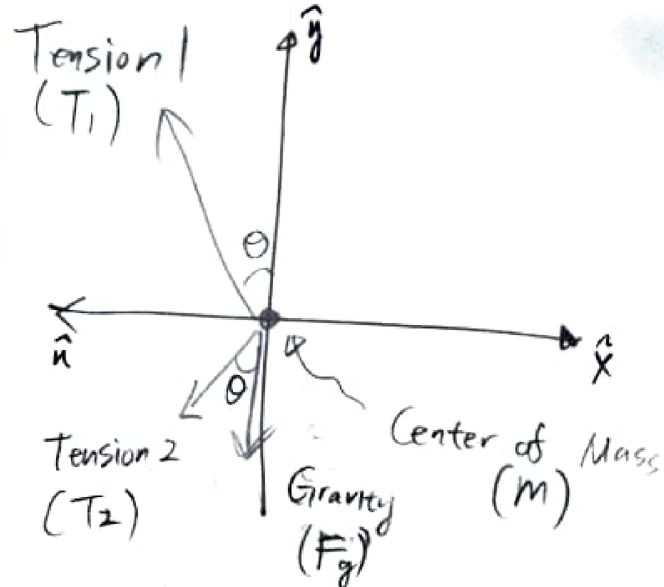
Q 3.1



assume
① $\hat{n}: \leftarrow$
② $\hat{x}: \rightarrow$
③ $\hat{y}: \uparrow$

Answer:



< Free-body Diagram >

Q 3.2

The ball is now in a "curving motion", $|F_{net}| = \left(\frac{mv^2}{R}\right) N$

According to the free-body diagram,

$$F_{net} = \vec{T_1} + \vec{T_2} + \vec{F_g} \quad \text{where} \quad \begin{cases} F_g = \langle 0, -mg, 0 \rangle N \\ T_1 = \langle -t_1 \sin\theta, +t_1\cos\theta, 0 \rangle N \\ T_2 = \langle -t_2 \sin\theta, -t_2\cos\theta, 0\rangle N \end{cases}$$

$$= \langle -\frac{mv^2}{R}, 0, 0 \rangle N$$

"unknown t_2"

Thus, we can get a system of equations.

$$\langle -t_1\sin\theta - t_2\sin\theta,\ t_1\cos\theta - t_2\cos\theta - mg,\ 0 \rangle N = \langle -\frac{mv^2}{R}, 0, 0\rangle N$$

$$\begin{cases} -t_1\sin\theta - t_2\sin\theta = -\frac{mv^2}{R} \cdots ① \\ t_1\cos\theta - t_2\cos\theta - mg = 0 \cdots ② \end{cases}$$ using substitution,

by ②, $t_1 = t_2 + \frac{mg}{\cos\theta}$, So ① be, $-\left(t_2 + \frac{mg}{\cos\theta}\right)\sin\theta - t_2\sin\theta = -\frac{mv^2}{R}$

Thus, $t_2(2\sin\theta) = \frac{mv^2}{R} - \frac{mg}{\cos\theta}(\sin\theta)$

Answer: $T_2 = \frac{mv^2}{2R\sin\theta} - \frac{mg}{2\cos\theta}$