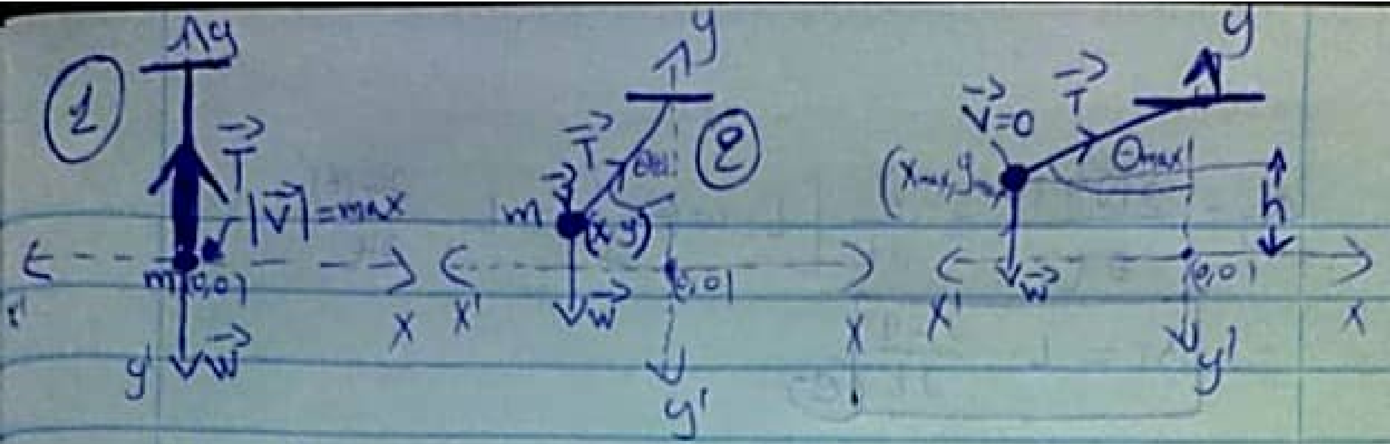

L = length of the rope, $L \in \mathbb{R}$ constant
m = mass of the object.

From Diagram 2:

$$\sin[\theta(t)] = \frac{x(t)}{L} \Rightarrow \boxed{x(t) = L \cdot \sin[\theta(t)]}$$

$$\cos[\theta(t)] = \frac{y(t)}{L} \Rightarrow \boxed{y(t) = L \cdot \cos[\theta(t)]}$$

$$\vec{r}(t) = x(t)\,\hat{x}_0 + y(t)\,\hat{y}_0 \Rightarrow \vec{r}(t) = L \cdot \sin[\theta(t)]\,\hat{x}_0 + L \cdot \cos[\theta(t)]\,\hat{y}_0$$

or $$\boxed{\vec{r}(t) = L \cdot \{\sin[\theta(t)]\,\hat{x}_0 + \cos[\theta(t)]\,\hat{y}_0\}}$$ a

$$|\vec{r}(t)| = \sqrt{L^2 \sin^2[\theta(t)] + L^2 \cos^2[\theta(t)]} = \sqrt{L^2 \{\sin^2[\theta(t)] + \cos^2[\theta(t)]\}}$$

$$= \sqrt{L^2 \cdot 1} \Rightarrow \boxed{|\vec{r}(t)| = L}$$ b

$$\frac{\partial \vec{r}(t)}{\partial t} = L \cdot \left\{\cos[\theta(t)] \cdot \frac{\partial \theta(t)}{\partial t}\,\hat{x}_0 - \sin[\theta(t)]\,\frac{\partial \theta(t)}{\partial t}\,\hat{y}_0\right\}$$

$$\Rightarrow \vec{r}(t) = L \cdot \{\omega(t) \cdot \cos[\theta(t)]\,\hat{x}_0 - \omega(t) \cdot \sin[\theta(t)]\,\hat{y}_0\}$$

$$\boxed{\vec{v}(t) = L \cdot \omega(t) \cdot \{\cos[\theta(t)]\,\hat{x}_0 - \sin[\theta(t)]\,\hat{y}_0\}}$$ c

$$|\vec{v}(t)| = \sqrt{L^2 \cdot \omega(t)^2 \cdot \cos^2[\theta(t)] + L^2 \omega(t)^2 \sin^2[\theta(t)]} \Rightarrow \boxed{|\vec{r}(t)| = L \cdot \omega(t)}$$ d

$$a_T = \frac{\partial |\vec{v}(t)|}{\partial t} = \frac{\partial}{\partial t}\left[L \cdot w(t)\right] = L \cdot \frac{\partial w(t)}{\partial t}$$

$$\Rightarrow \boxed{a_T = L \cdot \frac{\partial w(t)}{\partial t}} \; (e)$$

$$a_N = \frac{|\vec{v}|^2}{R} = \frac{\left[L \cdot w(t)\right]^2}{L} = \frac{L^2 \cdot w(t)^2}{L}$$

$$\Rightarrow \boxed{a_N = L \cdot w(t)^2} \; (f)$$

Newtons Law 2 - Diagram (2)

$$\sum \vec{F} = m \cdot \vec{a} \Leftrightarrow \vec{w} + \vec{T} = m \cdot \vec{a} \; \cancel{\Leftrightarrow -mg + T}$$

$$\Leftrightarrow -m \cdot g \hat{y}_0 + \vec{T} = m \cdot \vec{a}$$

$$\Leftrightarrow -mg\hat{y}_0 + T_1 \hat{x}_0 + T_2 \hat{y}_0 = m \cdot (a_1 \hat{x}_0 + a_2 \hat{y}_0)$$

$$\Leftrightarrow -g\hat{y}_0 + \frac{T_1}{m}\hat{x}_0 + \frac{T_2}{m}\hat{y}_0 = a_1 \hat{x}_0 + a_2 \hat{y}_0$$

$$\boxed{a_1 = \frac{T_1}{m}} \; (g) \qquad \boxed{a_2 = -g + \frac{T_2}{m}} \; (h)$$

If only $a_1 \equiv a_N$ and $a_2 \equiv a_T$ then I can find T_1 and T_2, but I'm not sure if this is true.

a_1, a_2 are in the X-Y dimensions but a_T, a_N in 3D space.