$B = \langle \frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}} \rangle$

$N = B \times T$

$$B \times T = \begin{vmatrix} i & j & k \\ 1 & 0 & 1 \\ -\sin t & \cos t & \sin t \end{vmatrix} \cdot \frac{1}{\sqrt{2}\cdot\sqrt{1+\sin^2 t}}$$

$$i(-\cos t) - j(2\sin) + k(\cos t)\frac{1}{\sqrt{2}\sqrt{1+\sin^2 t}}$$

$$N = \langle -\cos t, -2\sin t, \cos t \rangle \frac{1}{\sqrt{2}\sqrt{1+\sin^2 t}}$$

$$N = \frac{1}{\sqrt{2}\sqrt{1+\sin^2 t}} \langle -\cos t, -2\sin t, \cos t \rangle$$

OR solve for N by ...

$$a = \frac{d}{dt}|v|T + |v|^2 k N$$

$$a - \frac{d}{dt}|v|T = |v|^2 k N$$

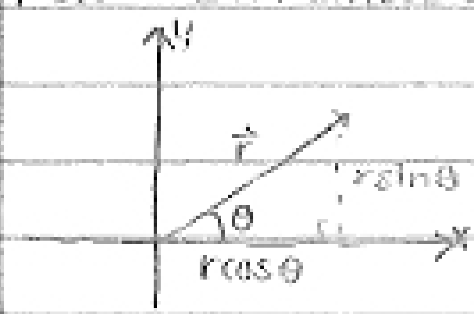
$$N = \frac{a - \frac{d|v|}{dt}T}{\left|a - \frac{d|v|}{dt}T\right|}$$

Not good unless speed is constant or easy to take derivative of.

9/8/14

* EXAM over Chapter 13 Friday during class!

Polar Coordinates



Angular momentum (L)

$$\vec{L} = m\vec{r} \times \vec{v}$$

$$\frac{d\vec{L}}{dt} = \frac{d}{dt} m\vec{r} \times \vec{v}$$

$$= m\left(\frac{d\vec{r}}{dt} \times \vec{v} + \vec{r} \times \frac{d\vec{v}}{dt}\right)$$

$$= m(\vec{v} \times \vec{v} + \vec{r} \times \vec{a})$$

$$= m\left(\vec{v} \times \vec{v} + \frac{g(r,\theta)}{m}\vec{r} \times \vec{r}\right)$$

$$= \vec{0}$$

$\vec{F} = -m\vec{a}$

$= g(r,\theta)\vec{r}$

* L is constant

So $\vec{r}$ & $\vec{v}$ are always in same plane.

$T = \frac{v(t)}{|v(t)|}$ $\quad N = \frac{dT}{dt} / \left|\frac{dT}{dt}\right|$ $\quad K = \frac{dT}{ds}$ $\quad s(t) = \int_0^t |v(u)|\, du$

$\vec{U}_\theta = \langle -\sin\theta, \cos\theta \rangle$ $\quad \vec{U}_r = \langle \cos\theta, \sin\theta \rangle$

$$\frac{d}{dt}\vec{U}_r = \left\langle \left(-\sin\theta \frac{d\theta}{dt}\right), (\cos\theta)\frac{d\theta}{dt} \right\rangle$$
$$= \frac{d\theta}{dt}\langle -\sin\theta, \cos\theta \rangle$$
$$= \frac{d\theta}{dt}\vec{U}_\theta$$
$$\frac{d}{d\theta}\vec{U}_r = \vec{U}_\theta$$
$$\frac{d}{d\theta}\vec{U}_\theta = -\vec{U}_r$$

$$\vec{V} = \frac{d\vec{r}}{dt}$$
$$= \frac{d}{dt}(r\,\vec{U}_r)$$
$$= \frac{dr}{dt}\vec{U}_r + r\frac{d\vec{U}_r}{dt}$$
$$= \frac{dr}{dt}\vec{U}_r + r\frac{d\theta}{dt}\vec{U}_\theta$$

$$\vec{L} = m\,r \times v$$
$$= m r \vec{U}_r \times \left(\frac{dr}{dt}\vec{U}_r + r\frac{d\theta}{dt}\vec{U}_\theta\right)$$
$$= mr^2\frac{d\theta}{dt}\vec{U}_r \times \vec{U}_\theta$$
$$= mr^2\frac{d\theta}{dt}\vec{k}$$

* $mr^2\frac{d\theta}{dt}$ is constant

Conect section

(F is origin)

$PF = e\,PD$

$r = (d + r\cos\theta)e$

$r - re\cos\theta = ed$

$r(1 - e\cos\theta) = ed$

$$r = \frac{ed}{1 - e\cos\theta}$$

e - eccentricity

$$\vec{F} = \frac{-mC}{r^2}\vec{U}_r$$