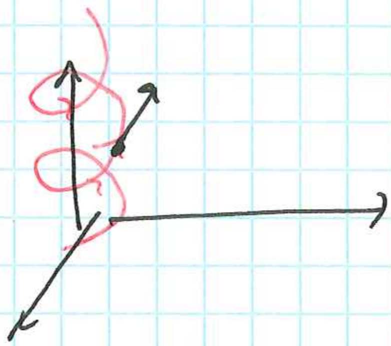
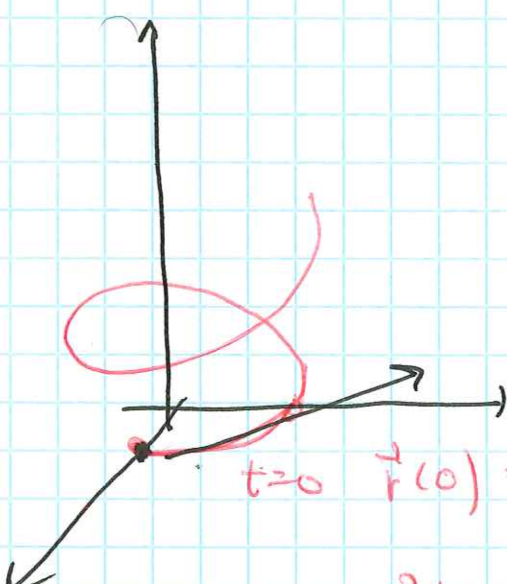
$x^2 - y^2 + z^2 = 1$

$\vec{r}(t) = \langle \cos t, \sin t, t \rangle$



$\vec{r}\,'(t) = \langle -\sin t, \cos t, 1 \rangle$

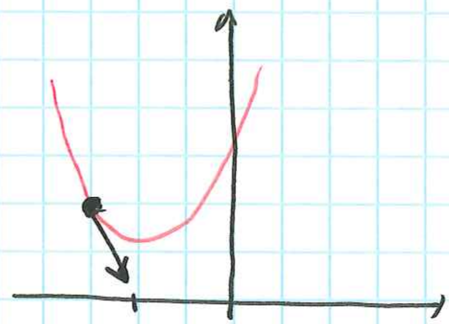


$t=0 \quad \vec{r}(0) = \langle 1, 0, 0 \rangle$

$\vec{r}\,'(0) = \langle 0, 1, 1 \rangle$

$\vec{r}(t) = \langle t-2, t^2+1 \rangle$

$\vec{r}\,'(t) = \langle 1, 2t \rangle$



$\vec{r}(-1) = \langle -3, 2 \rangle$

$\vec{r}\,'(-1) = \langle 1, -2 \rangle$

$\frac{d}{dt}\left(\langle t, 1-2t \rangle \cdot \langle t^2, t^3 \rangle \right) =$

$\langle 1, -2 \rangle \cdot \langle t^2, t^3 \rangle + \langle t, 1-2t \rangle \cdot \langle 2t, 3t^2 \rangle$

$\vec{r}(t) = \langle t, e^{-t}, 2t-t^2 \rangle$

$\vec{r}(??) = \langle 0, 1, 0 \rangle$ $\quad t=0$

$\vec{r}\,'(t) = \langle 1, -e^{-t}, 2-2t \rangle$

$\vec{r}\,'(0) = \langle 1, -1, 2 \rangle$

Parametric eq'n

$x(t) = \overset{0+}{t}$

$y(t) = 1 - t$

$z(t) = 0 + 2t$

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1 : $\vec{r}(t) = \langle t, t^2, t^3 \rangle$

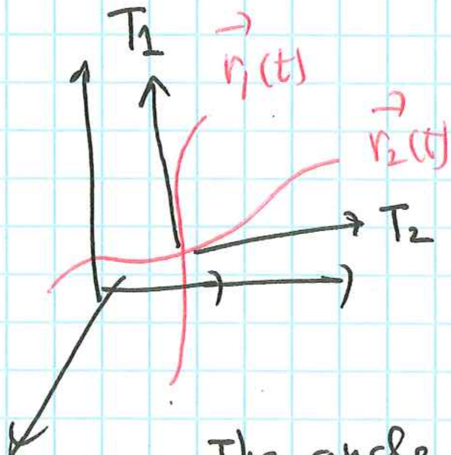
$\vec{r}'(t) = \langle 1, 2t, 3t^2 \rangle \qquad \vec{r}'(1) = \langle 1, 2, 3 \rangle$

$|\vec{r}'(1)| = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14}$

$\vec{r}''(t) = \langle 0, 2, 6t \rangle$

$\vec{T}(1) = \dfrac{\vec{r}'(1)}{|\vec{r}'(1)|} = \left\langle \dfrac{1}{\sqrt{14}}, \dfrac{2}{\sqrt{14}}, \dfrac{3}{\sqrt{14}} \right\rangle$

$\vec{r}'(t) \times \vec{r}''(t) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2t & 3t^2 \\ 0 & 2 & 6t \end{vmatrix} = (12t^2 - 6t^2)\hat{i} + -(6t)\hat{j} + 2\hat{k}$



The angle of intersection ~~between~~ of the two curves is the angle between the two tangent vectors of the point of intersection.

$\vec{r}_1(t) = \langle t, t^2, t^3 \rangle$

$\vec{r}_2(t) = \langle \sin t, \sin 2t, t \rangle$

$t=0 \Rightarrow$ the curves intersect at $(0,0,0)$

$\vec{r}_1\,'(t) = \langle 1, 2t, 3t^2 \rangle$

$\vec{r}_2\,'(t) = \langle \cos t, 2\cos 2t, 1 \rangle$

$\vec{r}_1\,'(0) = \langle 1, 0, 0 \rangle$

$\vec{r}_2\,'(0) = \langle 1, 2, 1 \rangle$

$$\frac{\vec{r}_1\,'(0) \cdot \vec{r}_2\,'(0)}{|\vec{r}_1\,'(0)| \cdot |\vec{r}_2\,'(0)|} = \cos\theta.$$

$$\cos\theta = \frac{\langle 1,0,0\rangle \cdot \langle 1,2,1\rangle}{|\langle 1,0,0\rangle|\ |\langle 1,2,1\rangle}$$

$$= \frac{1}{1\sqrt{6}} = \frac{1}{\sqrt{6}}$$

$$\vec{r}(t) = \langle t, 3\cos t, 3\sin t\rangle$$

$$\vec{r}'(t) = \langle 1, -3\sin t, 3\cos t \rangle$$

$$|\vec{r}'(t)| = \sqrt{1 + 3^2\sin^2 t + 3^2\cos^2 t} = \sqrt{10}$$

$$\int_{-5}^{5} |\vec{r}'(t)|\ dt = \int_{-5}^{5} \sqrt{10}\ dt = \sqrt{10}\cdot t\Big|_{t=-5}^{t=+5}$$

$$= 10\sqrt{10}$$

$$\vec{r}(t) = \langle 1, t^2, t^3\rangle$$

$$\vec{r}'(t) = \langle 0, 2t, 3t^2\rangle$$

$$|\vec{r}'(t)| = \sqrt{0 + 4t^2 + 9t^4}$$

$$L = \int_0^1 |\vec{r}'(t)|\,dt = \int_0^1 \sqrt{4t^2+9t^4}\ dt$$

$$\int_0^1 \sqrt{4t^2+9t^4}\,dt = \int_0^1 t\sqrt{4+9t^2}\,dt$$

$$\vec{r}(t) = \cos t\,\hat{i} + \sin t\,\hat{j} + t\,\hat{k}$$

$$\vec{r}'(t) = \langle -\sin t, \cos t, 1\rangle$$

$$|\vec{r}'(t)| = \sin^2 t + \cos^2 t + 1 = 2$$

$$s(t) = \int_0^t |\vec{r}'(u)|\,du$$

$$= \int_0^t \sqrt{2}\,du$$

$$= \sqrt{2}\,t$$

$$s = \sqrt{2}\,t$$

$$t = \frac{s}{\sqrt{2}}$$

$$\vec{r}(s) = \cos\left(\frac{s}{\sqrt{2}}\right)\hat{i} + \sin\left(\frac{s}{\sqrt{2}}\right)\hat{j} + \left(\frac{s}{\sqrt{2}}\right)\hat{k}$$