$r(t) = \langle 1,0,1\rangle + t\langle 2,3,4\rangle$

$= \langle 1+2t,\ 3t,\ 1+4t\rangle$

$\uparrow \quad \uparrow \quad \uparrow$

$f(t) \quad g(t) \quad h(t)$

① Domain: $t > -1$ $\quad t \neq -3, 3$

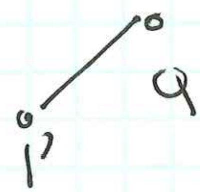
② Limit:

$1\,\cancel{2}\,\hat{i} + 3\,\hat{j} + -\pi\,\hat{k}$

$$\lim_{t\to 1}\left(\frac{t^2-t}{t-1}\right) = \lim_{t\to 1}\frac{(2t-1)}{1} = 1$$

$$\lim_{t\to 1}\frac{\sin \pi t}{\ln t} = \lim_{t\to 1}\frac{\pi\cos\pi t}{1/t} = \frac{-\pi}{1}$$

$P(2,0,0)$ to $Q(6,2,-2)$



Recall eq'n of line:

$$\vec{r}(t) = \vec{r}_0 + t\vec{v}$$

$$\vec{v} = \overrightarrow{PQ} = \langle 4, 2, -2 \rangle$$

$$\vec{r}(t) = \langle 2,0,0 \rangle + t\langle 4,2,-2 \rangle$$

$t=0 \quad \vec{r}(0) = \langle 2,0,0 \rangle = P$

$t=1 \quad \vec{r}(1) = \langle 6,2,-2 \rangle = Q$

Line segment: $0 \le t \le 1$

$$x(t) = 2 + 4t$$

$$y(t) = 2t$$

$$z(t) = -2t$$

$$\vec{r}(t) = (1-t)\langle 2,0,0 \rangle + t\langle 6,2,-2 \rangle$$

1 $x(t) = \cos(t)$

$y(t) = t$

$z(t) = \sin(t)$

$$x(t)^2 + z(t)^2 = \cos^2 t + \sin^2 t = 1$$

2 $x(t) = t\cos t$

$y(t) = t\sin t$

$z(t) = t$

claim: This curve lies on the surface

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

$$x(t)^2 + y(t)^2 = t^2\cos^2 t + t^2\sin^2 t$$

$$= t^2(\cos^2 t + \sin^2 t)$$

$$= t^2$$

$$z(t)^2 = t^2 \quad ✓$$

3 $x = \sin t \quad y = \cos t \quad z = \sin^2 t$

A: $z = x^2 \qquad x^2 = \sin^2 t \quad z = \sin^2 t$ ✓

B ✓

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

$$x^2 + y^2 + z^2 = 5$$

$$\sin^2 t + \cos^2 t + t^2 = 5$$

$$1 + t^2 = 5$$

$$t^2 = 4$$

$$t = \pm 2$$

Collision:

Equate x, y, z components of curves for same t

$t = 1+2t \Rightarrow 0 = 1+t \quad t = -1$

$t^2 = 1+6t \quad t=-1: \ 1 \neq 1+6(-1)$ X

$t^3 = 1+14t$

Intersection: find times s and t

$$\begin{cases} t = 1+2s \\ t^2 = 1+6s \\ t^3 = 1+14s \end{cases}$$

curve 1 curve 2

$t = 1+2s$ substitute:

$(1+2s)^2 = (1+6s)$

$\cancel{1} + 4s + 4s^2 = \cancel{1} + 6s$

$4s^2 - 2s = 0$

$2(2s-1) = 0 \Rightarrow s = 0,$
$s = 1/2$

$$\boxed{\begin{matrix} s = 0 \\ t = 1 \end{matrix}}$$