1. Determine whether or not the following lines intersect. If they do, find the point of intersection.
$\mathbf{r}_1 = (3+t)\mathbf{i} + (3-3t)\mathbf{j} + (-t)\mathbf{k}$
$\mathbf{r}_2 = (1+t)\mathbf{i} + (6t)\mathbf{j} + \mathbf{k}$

$3+t = 1+u$ $\quad$ $t=-1$
$3-3t = 6t$ $\quad \Rightarrow \quad$ $u=1$
$-t = 1$ $\quad$ $6=6\checkmark$

$\boxed{\text{intersect}}$

$r_1(-1) = 2\hat{i} + 6\hat{j} + \hat{k}$

$r_2(1) = 2\hat{i} + 6\hat{j} + \hat{k}$

intersect at $(2,6,1)$

2. Find the equation of the plane passing through $(1,0,0)$, $(0,1,0)$, and $(0,0,1)$
$P_1 \quad P_2 \quad P_3$

$\overrightarrow{P_1P_2} = \langle -1, 1, 0 \rangle$

$\overrightarrow{P_1P_3} = \langle -1, 0, 1 \rangle$

$\vec{N} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{vmatrix} = \hat{i} + \hat{j} + \hat{k}$

using P_1,

$1(x-1) + 1(y-0) + 1(z-0) = 0$

$x + y + z = 1$

3. Find the equation of the plane passing through $(-1,2,6)$, $(-1,-1,1)$, and $(0,-1,2)$
$P_1 \quad P_2 \quad P_3$

$\overrightarrow{P_2P_1} = \langle 0, 3, 5 \rangle$

$\overrightarrow{P_2P_3} = \langle 1, 0, 1 \rangle$

$\vec{N} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 3 & 5 \\ 1 & 0 & 1 \end{vmatrix} = 3\hat{i} + 5\hat{j} - 3\hat{k}$

$3(x+1) + 5(y-2) - 3(z-6) = 0$

$3x + 5y - 3z + 11 = 0$

4. Find the distance between the point $P(1,2,3)$ and the plane defined by $4x - y - 2z = 3$

$$\frac{|4\cdot 1 - 2 - 2\cdot 3 - 3|}{\sqrt{4^2 + 1^2 + 2^2}} = \frac{7}{\sqrt{21}}$$

5. Find the distance between the point $P(-1,-1,-1)$ and the plane defined by $-x + 2y - 5z = 1$

$$\frac{|-(-1) + 2(-1) - 5(-1) - 1|}{\sqrt{1^2 + 2^2 + 5^2}} = \frac{3}{\sqrt{30}}$$

no such thing

vector:

(6-8) Determine whether the following planes are Parallel, Identical, or Intersecting, or Skew. If intersecting, find the line where they intersect.

6. $3x + 4y - z = 1$
   $x - y + 5z = 6$

intersecting, since normal vectors have different directions.

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 4 & -1 \\ 1 & -1 & 5 \end{vmatrix} = \hat{i}(20-1) - \hat{j}(15+1) + \hat{k}(-3-4)$$

$$= 19\hat{i} - 16\hat{j} - 7\hat{k}$$

Find a point:

$x = 0$,

$4y - z = 1$
$-y + 5z = 6$ $\Rightarrow$ $z = \frac{25}{19}$, $y = \frac{11}{19}$

$$19(x-0) - 16\left(y - \frac{11}{19}\right) - 7\left(z + \frac{25}{19}\right) = 0$$

7. $16x + 4y - 12z = 20$
   $12x + 3y - 9z = 15$

$$(\text{eqn } 1) \cdot \frac{3}{4} = (\text{eqn } 2)$$

$\Rightarrow$ Identical

8. $2x + 6y - 10z = 4$
   $-5x - 15y + 25z = 4$

$$(\text{eqn } 2) \cdot \left(-\frac{2}{5}\right) = \left(2x + 6y - 10z = \frac{8}{5}\right)$$

parallel

9. Find the limit: $\lim_{t \to \infty} e^{-t}\mathbf{i} + \frac{4t^2+5}{2t^2+t}\mathbf{j} + \tan^{-1}(t)\mathbf{k}$

$$0\hat{i} + 2\hat{j} + \frac{\pi}{4}\hat{k}$$

$f'(t) = \langle -\sin t, \cos t, 1 \rangle$

$|f'(t)| = \sqrt{2}$

$\hat{T} = \frac{1}{\sqrt{2}} \langle \sin t, \cos t, 1 \rangle$

$\hat{T}' = \frac{1}{\sqrt{2}} \langle -\cos t, -\sin t, 0 \rangle$

$\hat{N} = \langle -\cos t, -\sin t, 0 \rangle$

$$\hat{B} = \frac{1}{\sqrt{2}} \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -\sin t & \cos t & 1 \\ -\cos t & -\sin t & 0 \end{vmatrix}$$

$= \sin t\,\hat{i} + \cos t\,\hat{j} - \hat{k}$

$f(0) = (1, 0, 0)$

$\hat{T} = \langle 0, 1, 1 \rangle$

$\hat{N} = \langle -1, 0, 0 \rangle$

$\hat{B} = \langle 0, 1, -1 \rangle$

Plane:

$0(x-1) + 1(y-0) - 1(z-0) = 0$

$\boxed{y - z = 0}$

10. Find the derivative, $\mathbf{T}$, $\mathbf{N}$, $\mathbf{B}$, and the osculating plane for $f(t) = \cos(t)\mathbf{i} + \sin(t)\mathbf{j} + t\mathbf{k}$

at $t = 0$