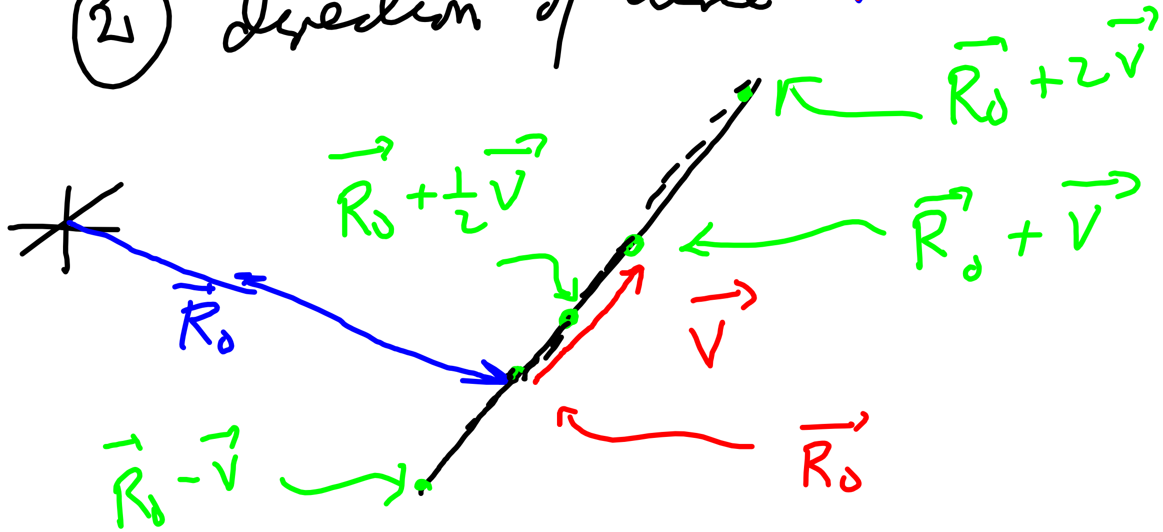
Equations for a straight line:

(1) point on line $\vec{R}_0$

(2) direction of line $\vec{V}$



Eq of line $\vec{R} = \vec{R}_0 + t\,\vec{V}$ $\quad -\infty < t < \infty$

dummy variable

"parameter"

Parametric Equation for a line

$$\vec{R} = \vec{R}_0 + t\,\vec{v}$$

$$\begin{array}{ccc}
 & x_0\vec{i} & v_1\vec{i} \\
\| & +y_0\vec{j} & +v_2\vec{j} \\
x\vec{i} & +z_0\vec{K} & +v_3\vec{K} \\
+y\vec{j} & & \\
+z\vec{K} & &
\end{array}$$

<u>Example:</u>

$$\vec{R} = \underbrace{\vec{i} + 2\vec{j}}_{\vec{i}+2\vec{j}\text{ on line}} + t\underbrace{\left(3\vec{i} + \vec{k}\right)}_{\parallel\text{ to }3\vec{i}+\vec{k}}$$

Component version

$$x = x_0 + t v_1 \qquad t = \frac{x - x_0}{v_1}$$

$$y = y_0 + t v_2 \qquad t = \frac{y - y_0}{v_2}$$

$$z = z_0 + t v_3 \qquad t = \frac{z - z_0}{v_3}$$

Non-parametric eqs. for line

$$\underbrace{\frac{x - x_0}{v_1} = \frac{y - y_0}{v_2}} \qquad \frac{y - y_0}{v_2} = \frac{z - z_0}{v_3}$$

With juggling, $y = mx + b$

$$\frac{x - x_0}{v_1} = \frac{y - y_0}{v_2} = \frac{z - z_0}{v_3}$$

$$\frac{x-1}{2} = 7y + 3 = \frac{z-0}{0}$$

$$7y+3 = \frac{y + 3/7}{1/7} = \frac{y - (-3/7)}{1/7}$$

Interpret

if $z=0$, $\frac{0}{0}$ (O.K.)

otherwise $\frac{z-0}{0} = \infty \neq \frac{x-1}{2}$

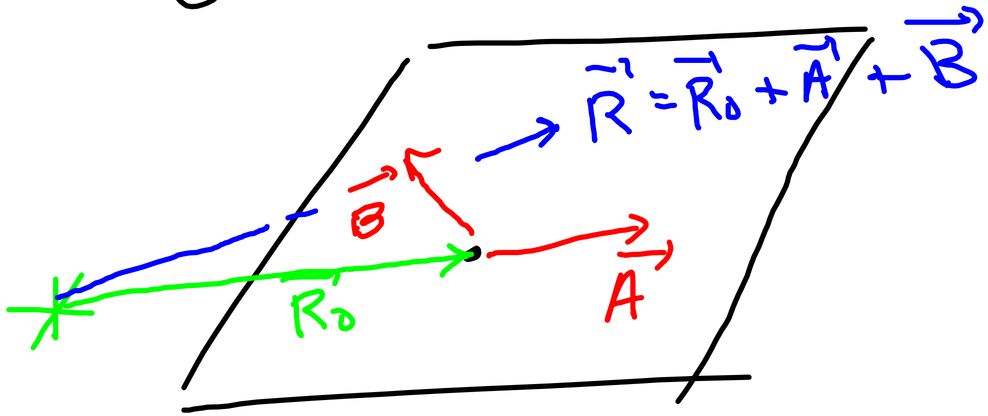
This is line through $(1, -\frac{3}{7}, 0)$ parallel to $2\vec{i} + \frac{1}{7}\vec{j}$

Equation for a plane.

Describe by

① a point in the plane $\vec{R}_0$

② 2 vectors ∥ to the plane



Generic pt. in plane

$$\vec{R} = \vec{R}_0 + s\vec{A} + t\vec{B}$$

Parametric Equation for a plane

$-\infty < s < \infty$

$-\infty < t < \infty$

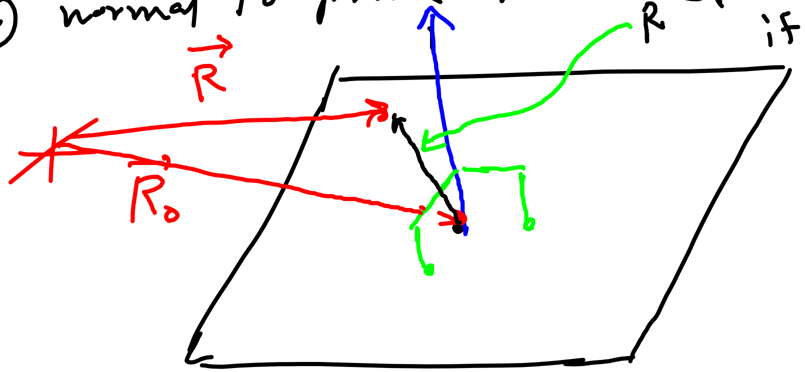
(2 parameters, 2-dimensional)

Eq for a plane

① pt in plane $\vec{R}_0$

② normal to plane $\vec{N}$

$\vec{R} - \vec{R}_0$ is $\perp$ to $\vec{N}$ if $\vec{R}$ lies in plane.



Non-parametric equation for a plane

$(\vec{R} - \vec{R}_0) \cdot \vec{N} = 0$ if & only if $\vec{R}$ is in the plane

$x\vec{i} + y\vec{j} + z\vec{k}$

$x_0\vec{i} + y_0\vec{j} + z_0\vec{k}$

$\vec{N} = N_1\vec{i} + N_2\vec{j} + N_3\vec{k}$

$$\vec{R} \cdot \vec{N} = \vec{R}_0 \cdot \vec{N}$$

$$xN_1 + yN_2 + zN_3 = d$$

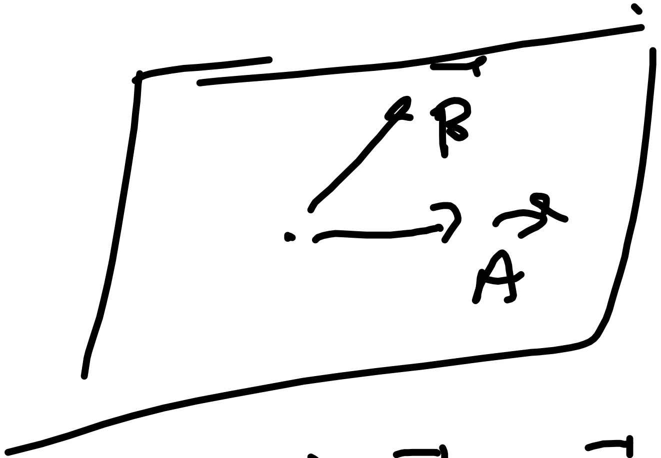
Write as $\boxed{ax + by + cz = d}$

Example:

$$\vec{R}_0 = \vec{i} + 2\vec{j} + \vec{k}$$

$\vec{A} = \text{——}$

$\vec{B} = \dots$



$$\vec{N} = \vec{A} \times \vec{B}$$

$$\vec{R} \cdot \vec{N} = \vec{R}_0 \cdot \vec{N}$$

$$ax + by + cz = d$$

$\vec{N}$

<u>Example</u> $x - 2y + 3z = 4$

Describe the plane.

(1) $\vec{N} = 1\vec{i} - 2\vec{j} + 3\vec{k}$ is normal to plane

(2) point in plane:

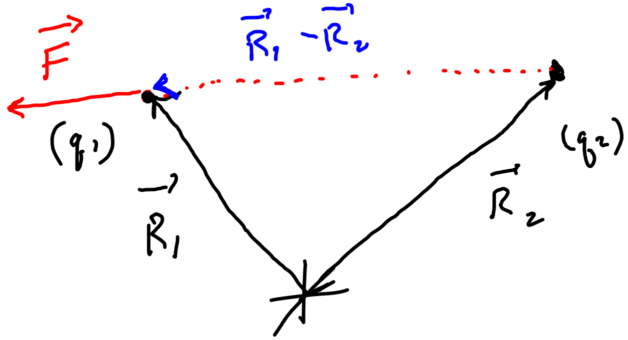
easy! e.g. $(4, 0, 0)$

or $(0, -2, 0)$

or $(0, 0, 4/3)$

Coulomb's force law.

$$|\text{Force}| \sim \frac{q_1 q_2}{(\text{distance})^2}$$



$$\vec F = (\text{scalar})\ \vec R_1 - \vec R_2$$

$$= \frac{(\vec R_1 - \vec R_2)}{|\vec R_1 - \vec R_2|^2}$$

wrong! This falls off like $\frac{1}{|\vec R_1 - \vec R_2|}$

$$\vec F = K q_1 q_2 \frac{\vec R_1 - \vec R_2}{|\vec R_1 - \vec R_2|^3}$$

Coulomb force