Closing Tues: 12.5(2)(3), 12.6
Closing Thurs: 13.1, 13.2

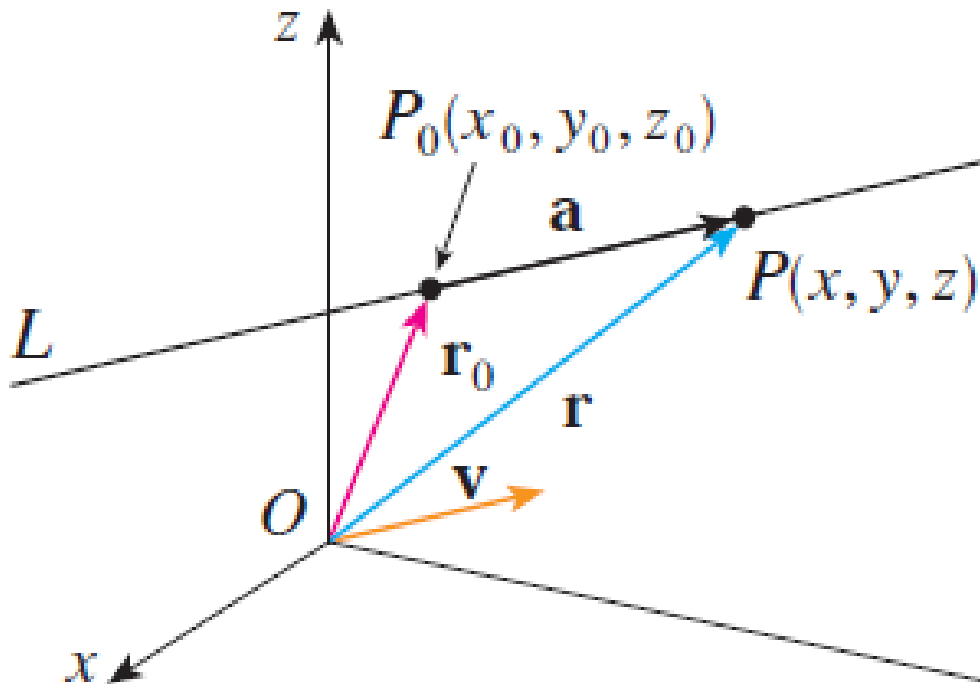*Entry Task*
1. Find the equation for the plane through (2,0,0), (0,3,0), (0,0,6).
2. Find the equation of the line through (0,0,1) and (5,4,3)
3. Find the intersection of this plane and this line.

LINES	PLANES
LINES	*PLANES*

Find **a direction vector** and **a point**

1. $v = \langle a, b, c \rangle$ *direction vector*
2. $r_0 = \langle x_0, y_0, z_0 \rangle$ *position vector*

All points (x,y,z) on the line satisfy:

$$\langle x, y, z \rangle = \langle x_0, y_0, z_0 \rangle + t \langle a, b, c \rangle$$
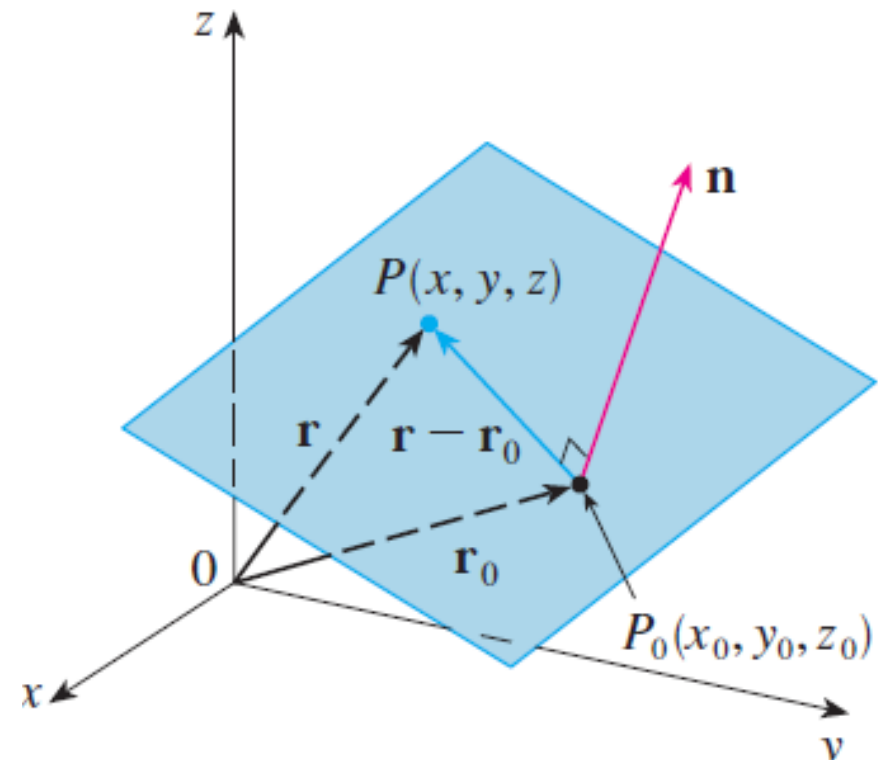
Find **a normal vector** and **a point**

1. $n = \langle a, b, c \rangle$ *normal vector*
2. $r_0 = \langle x_0, y_0, z_0 \rangle$ *position vector*

All points (x,y,z) on the plane satisfy:

$$\langle a, b, c \rangle \cdot \langle x - x_0, y - y_0, z - z_0 \rangle = 0$$

12.5 Summary

"Find the equation of a line…"

Step 1: Write
$$x = x_0 + at, y = y_0 + bt, z = z_0 + ct.$$

Step 2: Write down all the given information. Find a Point and a Direction.

"Find the equation of a plane…"

Step 1: Write
$$a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$

Step 2: Write down all the given information. Find a Point and a Normal.

To find equations for a line

Info given?

Find two points

Done.

$\vec{v} = \overrightarrow{AB}$
(subtract components)

$\overrightarrow{r_0} = \vec{A}$

To find the equation for a plane

Info given?

Find three points

Done.

Two vectors parallel to the plane: $\overrightarrow{AB}$ and $\overrightarrow{AC}$

$\vec{n} = \overrightarrow{AB} \times \overrightarrow{AC}$

$\overrightarrow{r_0} = \vec{A}$

1. Find an equation for the line that goes through the two points $A(1,0,-2)$ and $B(4,-2,3)$.

2. Find an equation for the line that is parallel to the line $x = 3 - t$, $y = 6t, z = 7t + 2$ and goes through the point $P(0,1,2)$.

3. Find an equation for the line that is orthogonal to $3x - y + 2z = 10$ and goes through the point $P(1,4,-2)$.

4. Find an equation for the line of
   intersection of the planes
   $$5x + y + z = 4 \text{ and}$$
   $$10x + y - z = 6.$$

1. Find the equation of the plane that goes through the three points A(0,3,4), B(1,2,0), and C(-1,6,4).

2. Find the equation of the plane that is orthogonal to the line
$x = 4 + t, y = 1 - 2t, z = 8t$ and
goes through the point P(3,2,1).

3. Find the equation of the plane that is parallel to $5x - 3y + 2z = 6$ and goes through the point P(4,-1,2).

4. Find the equation of the plane that contains the intersecting lines
$x = 4 + t_1, y = 2t_1, z = 1 - 3t_1$ and
$x = 4 - 3t_2, y = 3t_2, z = 1 + 2t_2.$

5. Find the equation of the plane that is orthogonal to $3x + 2y - z = 4$ and goes through the points P(1,2,4) and Q(-1,3,2).

1. Find the intersection of the line $x = 3t$, $y = 1 + 2t$, $z = 2 - t$ and the plane $2x + 3y - z = 4$.

2. Find the intersection of the two lines $x = 1 + 2t_1$, $y = 3t_1$, $z = 5t_1$ and $x = 6 - t_2$, $y = 2 + 4t_2$, $z = 3 + 7t_2$ (or explain why they don't intersect).

3. Find the intersection of the line

$x = 2t$, $y = 3t$, $z = -2t$ and the sphere

$x^2 + y^2 + z^2 = 16$.

4. Describe the intersection of the

plane $3y + z = 0$ and the sphere

$x^2 + y^2 + z^2 = 4$.

Questions directly from old tests:

1. Consider the line thru (0, 3, 5) that is orthogonal to the plane $2x - y + z = 20$. Find the point of intersection of the line and the plane.

2. Find the equation for the plane that contains the line $x = t, y = 1 - 2t, z = 4$ and the point (3,-1,5).