LINES AND PLANES IN SPACE

Review:

1. What two pieces of information are necessary for determining the equation of a line in the plane?

2. Write the slope-intercept form of a line.

3. Give a parametrization of the line above. *Hint: A parametrization is of the form* \((x(t), y(t)) = (\ldots, \ldots)\).

Def: Let \(L\) be a line in space. A **direction vector** \(v\) for \(L\) is . . .

Ex 1: Suppose a line \(L\) passes through the point \(P = (x_0, y_0, z_0)\) and has direction vector \(v = (a, b, c)\). Find a parametric equation for \(L\).
A Parametric Equation for a Line in Space Passing Through \((x_0, y_0, z_0)\) with Direction Vector \(⟨a, b, c⟩\):

**Def:** If the line \(L\) passes through \((x_0, y_0, z_0)\) and has direction vector \(⟨a, b, c⟩\), where \(a, b,\) and \(c\) are ALL not 0, then the **symmetric equations** for \(L\) are . . .

**Ex 2:** Find a parametric equation for a line \(L\) passing through the point \((-2, 0, 3)\) and having direction vector \(\mathbf{v} = (2, 4, -2/3)\).

**Ex 3:** Find a parametric equation of a line \(L\)

(a) passing through the points \((-2, 0, 3)\) and \((4, 12, 1)\).

(b) passing through the point \((-2, 0, 3)\) and parallel to the \(x\)-axis.
Planes

Ex 4: Find the equation of the plane that contains the point \( P = (x_0, y_0, z_0) \) and having normal vector \( n = \langle a, b, c \rangle \).

Standard Form for Equation of Plane Passing Through \((x_0, y_0, z_0)\) and normal to \(\langle a, b, c \rangle\):

General Form for Equation of Plane Passing Through \((x_0, y_0, z_0)\) and normal to \(\langle a, b, c \rangle\):

Ex 5: Find the equation of the plane parallel to the plane \(2x - 3y + 7z + 10 = 0\) and passing through the point \((-1, 8, 5)\).
Thm: The angle \( \theta \) between intersecting planes is given by

Ex 6: How can we tell if two planes will NOT intersect?

Ex 7: Consider the planes given by \( 2x - y + 6z + 7 = 0 \) and \( -3x + 2y + z - 10 = 0 \). Determine whether or not these planes intersect. If they do, then find the angle between them.

Thm: The distance between a plane with normal vector \( \mathbf{n} \) and a point \( Q \) not on the plane is given by . . .

Ex 8: Find the distance between the point \( (2, -5, 7) \) and the plane \( 3x - z = 3 \). Hint: Pick and easy point on the plane.