Lines & Planes

While working in a group make sure you:

- Expect to make mistakes but be sure to reflect/learn from them!
- Are civil and are aware of your impact on others.
- Assume and engage with the strongest argument while assuming best intent.

Some line equations (in 2D):

- Algebra: $y = mx + b$ $\qquad$ $y - y_0 = m(x - x_0)$ $\qquad$ $Ax + By + C = 0$
- Vectors: Let $t \in \mathbb{R}$, then

  - Position Vectors of form: $\langle x, y \rangle = \langle x_0, y_0 \rangle + t\overrightarrow{v}$
  - (Position) Vector Equations: $\langle x, y \rangle = (x_0 + tv_1)\langle 1, 0 \rangle + (y_0 + tv_2)\langle 0, 1 \rangle$
  - Parametric Equations: $x = x_0 + tv_1$ and $y = y_0 + tv_2$
  - Symmetric Equations: $\dfrac{x - x_0}{v_1} = \dfrac{y - y_0}{v_2}$

1. Consider the line L passing through $P(1, 2, -1)$ and $Q(2, 2, 3)$.

   (a) Find two equations for L

   (b) Where does L intersect the yz plane?

Some Plane equations (in 3D):

- Algebra: $z = z_0 + m_x(x - x_0) + m_y(y - y_0)$ $\qquad$ $Ax + By + Cz + D = 0$
- Vectors: Let $t \in \mathbb{R}$, $s \in \mathbb{R}$, $\eta = \langle a, b, c \rangle$ and perpendicular to the plane, then
  - Position Vectors of form: $\langle x, y, z \rangle = \langle x_0, y_0, z_0 \rangle + t\vec{v} + s\vec{w}$
  - Vector Equations: $\vec{\eta} \cdot (\langle x, y, z \rangle - \langle x_0, y_0, z_0 \rangle) = 0$
  - Scalar Form: $a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$

2. Consider the vector $\vec{\eta} = 3\vec{i} + 1\vec{j} + 2\vec{k}$.

   (a) Graph $\vec{\eta}$.

   (b) Sketch the plane that is perpendicular

   (c) Find the vector equation to the plane that is perpendicular to $\vec{\eta}$.
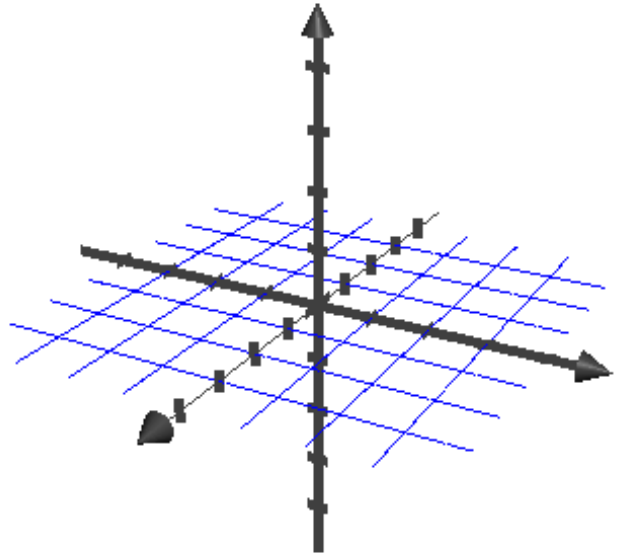
   (d) Find the vector equation to the plane that is perpendicular to $\vec{\eta}$ and also passes through $P(-2, 0, 1)$.