

MATH 1183D Geometry, cross products and lines

1. Consider the points $P(1, 0, 2)$ and $Q(0, 1, 0)$.

(a) Draw a set of 3D axes and plot P and Q .

(b) Find the vector \overrightarrow{PQ} , and use it to find the distance between P and Q .

2. Let $\mathbf{u} = \begin{bmatrix} 1 \\ 0 \\ 3 \end{bmatrix}$ and $\mathbf{v} = \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}$. Calculate each of the following.

(a) $\mathbf{u} \times \mathbf{v}$

(b) $\mathbf{v} \times \mathbf{u}$

(c) $\mathbf{u} \cdot (\mathbf{u} \times \mathbf{v})$.

(d) $\mathbf{v} \cdot (\mathbf{u} \times \mathbf{v})$.

3. Consider the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$.

(a) Find the area of the triangle.

(b) Based on your answer to (a), are the points $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ colinear (*i.e.* do they all lie on the same line)?

(c) Find a nonzero vector that is perpendicular to the plane containing the triangle.

4. Write down the vector equation of the line passing through $P(1, 0, 2)$ in the direction of

$$\mathbf{u} = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}.$$

5. A line L passes through the points $P(1, -1, 1)$ and $Q(-1, 2, -1)$. Find the point at which L intersects the xy -plane, if it exists.

6. Where does the line through $(-3, 1, 0)$ and $(-1, 5, 6)$ intersect the plane $2x + y - z = -2$?

7. Find a parametric equation for the line of intersection between the planes $x + y + z = 1$ and $x + 2y + 2z = 1$, and the angle at which they intersect.