Four points \( P(1, 3, 4), Q(3, -4, -5), R(0, -5, 0), \) and \( S(2, 6, t) \) generate six vectors:
\( \mathbf{a} = \overrightarrow{PQ}, \mathbf{b} = \overrightarrow{PR}, \mathbf{c} = \overrightarrow{PS}, \mathbf{d} = \overrightarrow{QR}, \mathbf{e} = \overrightarrow{QS}, \mathbf{f} = \overrightarrow{RS} \). They are used in Problems 0-7.

0. Compute the following vectors

\[
\mathbf{a} = \\
\mathbf{b} = \\
\mathbf{c} = \\
\mathbf{d} = \\
\mathbf{e} = \\
\mathbf{f} = 
\]

1. Vectors

\[
7\mathbf{a} = \\
\mathbf{b} + \mathbf{d} = \\
\mathbf{a} \times \mathbf{b} = 
\]

2. Magnitudes

\[
||\mathbf{a}|| = \\
||\mathbf{b} - \mathbf{d}|| = \\
||\mathbf{a} \times \mathbf{b}|| = 
\]

3. The dot product.

\[
\mathbf{e} \cdot \mathbf{f} = \\
\text{What } t \text{ would make } \mathbf{a} \text{ orthogonal to } \mathbf{f}? \ t = \\
\text{Compute } \text{proj}_\mathbf{b}\mathbf{c} = \\
\text{Compute the vector component of } \mathbf{c} \text{ orthogonal to } \mathbf{b} \\
\text{Approximate the angle between vectors } \mathbf{a} \text{ and } \mathbf{c}, \theta = \\
\text{Approximate the angle between vector } \mathbf{d} \text{ and the positive } y\text{-axis}, \beta = 
\]
4. The cross product

Compute the area of the $\triangle PQR$

Compute $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) =$

Find two unit vectors orthogonal to both $\mathbf{a}$ and the $z$-axis

5. Lines and Planes

Write an equation of a line that contains points $P$ and $Q$.

Write an equation of a line that contains point $P$ and vector $\mathbf{c}$.

Write an equation of a line through point $Q$ and perpendicular to the plane $2x - 3y - 7z = 10$.

Find the point of intersection of the plane $2x + 3y + z - 3 = 0$ and the line $\frac{x + 2}{2} = \frac{y - 3}{3} = \frac{z - 1}{1}$.

6. Surfaces in Space

Identify the following surfaces

$$3x^2 + 3y^2 + 3z^2 - 2z + 3y - 11 = 0$$
$$4x^2 - 9y^2 - 36z = 0$$

Write an equation of a cylinder which contains point $R$ and whose rulings are parallel to the $y$-axis and is generated by a circle centered at $(1, 2, 3)$.

Find the center and radius of the sphere $x^2 + y^2 + z^2 - 4x - 2y + 2z = 10$.

7. Systems of Coordinates

Point $(3, 3\pi/4, \pi/3)$ is in spherical coordinates. Find its cylindrical and rectangular coordinates.

Point $(3, -3, 7)$ is in rectangular coordinates. Convert it into cylindrical and spherical coordinates.

Find an equation in spherical coordinates of the surface given by the rectangular equation $x^2 - y^2 = z$.

Find an equation in cylindrical coordinates of the surface given by the rectangular equation $x^2 - y^2 = z$. 