Consider the points \( P = (1, 1, 3) \) and \( Q = (3, -1, 4) \).

(a) [1] Find the vector \( \overrightarrow{PQ} \).

\[
\overrightarrow{PQ} = \langle 2, -2, 1 \rangle
\]

(b) [1] Find a unit vector in the direction of \( \overrightarrow{PQ} \).

\[
\overrightarrow{e}_{PQ} = \frac{1}{3} \langle 2, -2, 1 \rangle \quad \text{since} \quad ||\overrightarrow{PQ}|| = \sqrt{4+4+1} = 3
\]

(c) [1] Find a parametric representation of the line through \( P \) and \( Q \).

\[
x = 1 + 2t \\
y = 1 - 2t \\
z = 3 + t
\]

(d) [1] Find a vector representation of the line through \( P \) and \( Q \).

\[
\vec{r}(t) = \langle 1, 1, 3 \rangle + t \langle 2, -2, 1 \rangle
\]

2. [2] Is the angle between the vectors \( u = \langle 1, 2, 3 \rangle \) and \( v = \langle 3, -1, -1 \rangle \) acute, right, or obtuse?

\[
\vec{u} \cdot \vec{v} = 3 - 2 - 3 = -2 < 0 \quad \text{so obtuse}
\]

3. [2] Find \( x \) so that the vectors \( u = \langle x, 2 \rangle \) and \( v = \langle 3, 1 - x \rangle \) are orthogonal.

\[
\vec{u} \cdot \vec{v} = 3x + 2 - 2x = 0 \quad \text{so orthogonal iff} \quad \vec{u} \cdot \vec{v} = 0,
\]

\[
\text{so} \quad x + 2 = 0 \quad \text{or} \quad x = -2.
\]