1) All True

2) \[ |\mathbf{v}| = \sqrt{(2)^2 + (3)^2 + (-1)^2} = 7 \]
   \[ \hat{v} = \frac{\mathbf{v}}{|\mathbf{v}|} = \left( \frac{2}{7} \right) \mathbf{i} + \left( \frac{3}{7} \right) \mathbf{j} - \left( \frac{1}{7} \right) \mathbf{k} \]

3) The vector from \(P\) to \(Q\) is
   \[ \mathbf{u} = (0-1)\mathbf{i} + (2-0)\mathbf{j} + (1-3)\mathbf{k} = -\mathbf{i} + 2\mathbf{j} - 2\mathbf{k} \]
   \[ |\mathbf{u}| = \sqrt{(-1)^2 + (2)^2 + (-2)^2} = 3 \]
   So the vector from \(P\) to \(Q\) is given by \(\mathbf{u}\)
   \[ \mathbf{u} = (-\frac{1}{3})\mathbf{i} + (\frac{2}{3})\mathbf{j} - (\frac{2}{3})\mathbf{k} \]

4) Vectors \(\mathbf{a}, \mathbf{b}\), and \(\mathbf{c}\) are linearly dependent if there exists constants \(\lambda, \mu, \) and \(\nu\) (not all zero) such that \(\lambda\mathbf{a} + \mu\mathbf{b} + \nu\mathbf{c} = \mathbf{0}\). Breaking the vectors into components gives
   \[ \lambda a_x + \mu b_x + \nu c_x = 0 \]
   \[ \lambda a_y + \mu b_y + \nu c_y = 0 \]
   \[ \lambda a_z + \mu b_z + \nu c_z = 0 \]
   This set has a non-zero solution for \(\lambda, \mu, \) and \(\nu\) provided that the determinant of coefficients vanishes, or
   \[ \begin{vmatrix} a_x & b_x & c_x \\ a_y & b_y & c_y \\ a_z & b_z & c_z \end{vmatrix} = 0 \]

   Which is equivalent to \(\mathbf{a} \times \mathbf{b} \times \mathbf{c} = \mathbf{0}\)

   Substituting
   \[ \begin{vmatrix} 3 & 1 & -2 \\ 4 & -1 & -1 \\ 1 & -2 & 1 \end{vmatrix} = -3 - 16 - 2 + 4 + 6 = 0 \]

   So \(\mathbf{u}, \mathbf{v}\), and \(\mathbf{w}\) are linearly dependent and \(\mathbf{v} = \mathbf{u} + \mathbf{w}\)
3) First, let \( a_{ij} = \cos(x_i', x_j) \)

The relative orientation of the individual axes of each system with respect to the other is given by:

\[
\begin{array}{ccc}
& x_1 & x_2 & x_3 \\
X_1' & a_{11} & a_{12} & a_{13} \\
X_2' & a_{21} & a_{22} & a_{23} \\
X_3' & a_{31} & a_{32} & a_{33}
\end{array}
\]

This can be written as a transformation tensor as:

\[ A = \begin{pmatrix}
  a_{11} & a_{12} & a_{13} \\
  a_{21} & a_{22} & a_{23} \\
  a_{31} & a_{32} & a_{33}
\end{pmatrix} \]

If we define the unit vector along the \( x_i' \) direction as \( \hat{e}_i' \), then

\[ \hat{e}_i' = a_{ij} \hat{e}_j \]

So, an arbitrary vector in the unprimed system is given by:

\[ \vec{V} = v_j \hat{e}_j \]

and in the primed system:

\[ \vec{V}' = v'_i \hat{e}'_i \]

Making the appropriate substitution gives:

\[ \vec{V} = v'_i a_{ij} \hat{e}_j \]

The vector components between the two systems are then related by:

\[ v'_i = a_{ij} v_j \]