(1) Describe and sketch the surfaces in space defined by the following equations:

\begin{itemize}
  \item (i) \( z = -1 \)
  \item (ii) \( x^2 + z^2 = 3 \)
  \item (iii) \( z = y^2 \)
  \item (iv) \( yz = 1 \)
  \item (v) \( z = -y + 1 \)
\end{itemize}
(2) Let \( \vec{a} = \langle \sqrt{2}, 1, 1 \rangle \) and \( \vec{b} = \langle -\sqrt{2}, 4, -1 \rangle \) be two vectors in \( \mathbb{R}^3 \). (10pts)

- i) Find the scalar projection and vector projection of \( \vec{b} \) onto \( \vec{a} \).
- ii) Find the angle between the vectors \( \vec{a} \) and \( \vec{a} + \vec{b} \).
- iii) If \( \vec{r} = \langle x, y, z \rangle \), show that the vector equation \( (\vec{r} - \vec{a}) \cdot (\vec{r} - \vec{b}) = 0 \) represents a sphere.
(3) (a) Find the angle that the vector \( \mathbf{v} = -\sqrt{3}\mathbf{j} + \mathbf{k} \) makes with the positive \( y \)-axis. 

(b) Find all unit vectors parallel to the \( xz \)-plane that are perpendicular to the vector \( 2\mathbf{i} - 3\mathbf{j} - \mathbf{k} \). 

(c) If a vector has direction angles \( \alpha = \pi/4 \) and \( \beta = \pi/3 \), find the third direction angle \( \gamma \).
(4) (a) Let \( \vec{a} = \overrightarrow{OP} \), where \( P \) is the point \((2, 2, \sqrt{2})\). Compute the vectors \( \vec{b} \) and \( \vec{c} \).

(3pts)

(b) Let \( \vec{a}, \vec{b} \) and \( \vec{c} \) be three vectors in the plane \( 3x - 5y + 6z = 7 \). Compute

\[
(-\vec{a} + 4\vec{b} - 7\vec{c}).(-3\vec{i} + 5\vec{j} - 6\vec{k}).
\]

(7pts)
(5) Given the points $A(1, 0, 1)$, $B(2, 3, 0)$, $C(-1, 1, 4)$, and $D(0, 3, 2)$, find the volume of the parallelepiped with adjacent edges $AB$, $AC$, and $AD$. (10pts)