1 (5 points). Find the equation of the sphere satisfying the following conditions: the line segment joining (0, 4, 2) and (6, 0, 2).
2 (5 points). Find the vector of norm 2 in the direction of \( \mathbf{i} - 2\mathbf{j} + 2\mathbf{k} \).
3 (5 points). Find all vectors $v = ai + bj$ that have norm 3 and the $i$-component is twice $j$-component. Picture the vectors.
4 (5 points). Find the angle between the vectors \( \mathbf{a}(2, -3, 1) \) and \( \mathbf{b}(-3, 1, 9) \)
5 (5 points). Find all numbers $x$ for which

$$(x \mathbf{i} + 11 \mathbf{j} - 3 \mathbf{k}) \perp (2x \mathbf{i} - x \mathbf{j} - 5 \mathbf{k})$$
6 (20 points). Given three points $Q(1, 0, 2), R(2, 2, 1)$ and $P(0, 1, 4)$, Find:

the coordinates of the forth vertex $S$ of parallelogram $QPRS$.

the area of $PQRS$

the angle of $\triangle QPR$ at the vertex $S$

the equation of the plane containing the points $S$, $Q$ and $R$

equations for the line through the point $Q$ which is perpendicular to the plane containing $\triangle PQS$. 
7 (5 points). Let \( a = a_1 \mathbf{i} + a_2 \mathbf{j} \) and \( b = b_1 \mathbf{i} + b_2 \mathbf{j} \). Show that \((a \times b) \parallel \mathbf{k}\).
8 (10 points). Show that the following 4 points: $A(-3, 4, 7), B(2, -4, 0), C(1, 2, -1), D(1, 1, 2)$ are not in the same plane. If so, find the volume of parallelepiped determined by $\vec{AB}, \vec{AC}$ and $\vec{AD}$. 
9 (5 points). Find the symmetric equation of the line that passes through the point \((2, -2, 1)\) and is parallel to the \((yz)\) plane.

10 (15 points). Find the vector parametric equation of the line segment connecting two points \(P(6, 6, 1)\) and \(Q(-3, 2, 0)\). Find the symmetric equation of the line passing through these points.
11 (10 points). Find the distance from the point $P_1(0, 0, 2)$ to the line $l : \mathbf{r}(t) = 2\mathbf{i} - 3\mathbf{k}$.

12 (10 points). Find the equation of the plane that contains the lines $l_1$ and $l_2$ that pass through the point $(1, 3, -2)$ and have the corresponding direction vectors:

$$d_1 = \mathbf{i} + 2\mathbf{j} + 4\mathbf{k} \quad \text{and} \quad d_2 = -\mathbf{i} - \mathbf{j} + 3\mathbf{k}.$$
13 (20 points). Find the scalar parametric equation of the line of intersection of two planes \(2x - 3y + z - 1 = 0\) and \(-x + y - z = 0\).
14 (10 points). Find the angle at the intersection point of the line \( \mathbf{r}(t) = t\mathbf{d} \), where \( \mathbf{d}(1, 0, 1) \) and the plane \( x + y - z = 0 \)