Question 1:

(a) Give the equation of the plane through the point $(-3, 4, 7)$ that is parallel to the xy-plane.

[2]

(b) The point (a, a, a) is located in the first octant (where $x \geq 0$, $y \geq 0$ and $z \geq 0$) at a distance 5 from the origin. Find the equation of the sphere of largest diameter that is located in the first octant and has (a, a, a) as the center.

[3]

(c) Find an equation for the set of all points (x, y, z) that are equidistant from the points $(0, 0, 2)$ and $(1, 1, 1)$. Simplify your equation as much as possible.

[5]

Question 2: For this question use the vectors

$$\mathbf{a} = 2\mathbf{i} - \mathbf{j} + 3\mathbf{k}, \quad \mathbf{b} = 3\mathbf{i} - 2\mathbf{j} + \mathbf{k} \quad \text{and} \quad \mathbf{c} = \mathbf{i} + \mathbf{j} + \mathbf{k}$$

(a) Compute $|\mathbf{a} - 3\mathbf{c}|$.

[2]

(b) Compute $|a \times b|$.

[2]

(c) Compute $\text{proj}_{\mathbf{a}}\mathbf{b}$.

[3]

(d) Find a vector of magnitude 5 that is parallel to $\mathbf{b}$ but pointing in the opposite direction.

[3]

Question 3: Determine all values of x for which $\langle 3, 2, x\rangle$ and $\langle 2x, 4, x\rangle$ are orthogonal.

[5]

Question 4: Find orthogonal vectors $\mathbf{a}$ and $\mathbf{b}$ such that $\mathbf{a}$ is parallel to $\langle 1, 1, 1\rangle$ and $\mathbf{a} + \mathbf{b} = \langle 1, -2, 4\rangle$.

[5]

Question 5: Find all values of x such that the angle between $\langle 2, 1, -1\rangle$ and $\langle 1, x, 0\rangle$ is $\pi/4$.

[5]

Question 6: Find a unit normal vector to the plane containing the points $P(1, -3, -2)$, $Q(2, 0, -4)$ and $R(6, -2, -5)$.

[5]

Question 7:

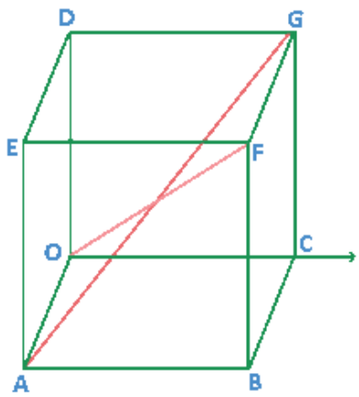
(a) Find the area of the triangle having vertices the points $P(1, -3, -2)$, $Q(2, 0, -4)$ and $R(6, -2, -5)$.

[2]

(b) Is the triangle in part (a) a right triangle?

[3]

Question 8: Find the acute angle between the two diagonals OF and AG of a cube. If giving a decimal answer, round your final answer to one decimal place.



[5]