Question 1(3+1+1). a) Find the angle between the vectors $\overrightarrow{M_1M_2}$ and $\overrightarrow{M_1M_3}$ if

$$M_1(6,-3,-7),\ M_2(2,5,13)\ and\ M_3(4,1,3)$$

b) Show that the points $M_1, M_2\ and\ M_3$ lie on a straight line.

c) Find the area of the parallelogram formed by the vectors $\overrightarrow{M_1M_2}\ and\ \overrightarrow{M_2M_3}$.

Question 2 (2+2+2). a) Find the equations of the tangent plane U to the surface given by the

equation $x^3 - y^2 + z^2 + 2 = 0$ at the point $M(1,2,1)$.

b) Find symmetric and parametric equations of the line L through the point

$M(2,3,-1)$ and parallel to the normal vector to the plane U.

c) Find the equation of the plane passing the point $M(2,3,-1)$ and

perpendicular to the line L.

Question 3 (2+2). a) write and sketch the domain of the function $f(x,y) = \dfrac{x}{y} + \ln\dfrac{x}{y}$.

b) Find the $\displaystyle\lim_{(x,y)\to(0,0)} \dfrac{x - y + 2\sqrt{x} - 2\sqrt{y}}{\sqrt{x} - \sqrt{y}}$

Question 4 (3). Define $f(0,0)$ in a way that extends $f(x,y) = \dfrac{x^6 y + x^2 y^3}{(x^4 + y^2)^2}$

to be continuous at the origin.

Question 5 (3). Find $f_x(0,0)$ and $f_y(0,0)$ if $f(x,y) = \begin{cases} \dfrac{\sin(x^3 + y^4)}{x^2 + y^2}, & (x,y) \neq (0,0) \\ 0, & (x,y) = (0,0) \end{cases}$

Question 6 (4). Find the derivative of $f(x,y) = \dfrac{x-y}{xy+2}$ at $(1,1)$ in the direction of $v = 12i + 5j$.