1. Given: \( \mathbf{u} = <3, 5, -2>, \mathbf{v} = <-1, 4, 1>, \mathbf{w} = <2, -2, 1> \)

Find:

a. \( \mathbf{u} \cdot (3\mathbf{v} - 2\mathbf{w}) \)

b. \( |\mathbf{u} + \mathbf{v}| \)

c. \( \mathbf{w} \times \mathbf{u} \)

d. the angle (in radians) formed by \( \mathbf{v} \) and \( \mathbf{w} \).

e. A nonzero vector that is parallel to the \( yz \)-plane, and orthogonal to \( \mathbf{w} \).

2. a. Find the vector equation of the line passing through the points \((3, 7, 2)\) and \((-1, 8, 5)\).

b. Find the parametric equations of the line passing through the point \((2, 5, -1)\) that is parallel to the line whose vector equation is \( \mathbf{r}(t) = <5 - 2t, -2 + 3t, 7 + 5t> \).

3. Given the points \((0, 3, 2)\), \((1, 4, 5)\), and \((2, 2, 3)\):

a. Find the equation of the plane that passes through these points. Write your answer in the form \( ax + by + cz = d \).

b. Find the area of the triangle with these three vertices.

4. Given the curve defined by the vector function \( \mathbf{r}(t) = <3t^2, \sin t - t \cos t, \cos t + t \sin t> \), find:

a. \( \mathbf{r}'(t) \)

b. The length of the curve between \( t = 0 \) and \( t = \frac{\pi}{2} \).

c. \( \mathbf{T}(\frac{\pi}{3}) \).

5. Evaluate: \( \int_0^1 \left( \frac{t}{1+t^2} \mathbf{i} + \frac{2}{1+t^2} \mathbf{j} - \frac{4t}{1+t^2} \mathbf{k} \right) dt \)

6. Given \( f(x, y) = \ln(x^2 - 4y) + x^2y \):

a. Sketch the domain of \( f(x, y) \).

b. Find \( f_x(x, y) \), \( f_{xy}(x, y) \) and \( f_{yy}(x, y) \)

7. Given \( f(x, y) = \ln(x^2 - 4y) + x^2y \) (this is the same function as in problem 6):

a. Find the equation of the tangent plane to the curve \( z = f(x, y) \) at the point \((3, 2, f(3, 2))\). Write your answer in the form \( ax + by + cz = d \).

b. If \((x, y)\) changes from \((3, 2)\) to \((3.2, 1.9)\), estimate the value of \( \Delta z \) by finding the total differential \( dz \).
1. a. 57  
   b. \( \sqrt{86} \)  
   c. \( < -1, 7, 16 > \)  
   d. \( \frac{3\pi}{4} \)  
   e. any vector of form \( < 0, b, 2b > \)

2. a. \( \mathbf{r}(t) = < 3 - 4t, 7 + t, 2 + 3t > \)  
   b. \( x = 2 - 2t \) \( y = 5 + 3t \) \( z = -1 + 5t \)
   or \( \mathbf{r}(t) = < -1 - 4t, 8 + t, 5 + 3t > \)

3. a. \( 4x + 5y - 3z = 9 \)  
   b. \( \text{Area} = \frac{|AB \times AC|}{2} = \frac{\sqrt{50}}{2} \)

4. a. \( < 6t, t \sin t, t \cos t > \)  
   b. \( \frac{\pi^2 \sqrt{37}}{8} \)
   c. \( < \frac{6}{\sqrt{37}}, \frac{\sqrt{3}}{2\sqrt{37}}, \frac{1}{2\sqrt{37}} > \)

5. \( (1 - \ln 2)\mathbf{i} + \left( \frac{\pi}{2} \right) \mathbf{j} - (2 \ln 2) \mathbf{k} \)

6. a. Domain is region below the curve \( y = \frac{x^2}{4} \)
   b. \( f_x(x, y) = \frac{2x}{x^2-4y} + 2xy \)
   \( f_{xy}(x, y) = \frac{8x}{(x^2-4y)^2} + 2x \)
   \( f_{yy}(x, y) = \frac{-16}{(x^2-4y)^2} \)

7. a. \( 18x + 5y - z = 46 \)
   b. \( dz = 3.1 \)