
Topics

1. Vector operations (dot product, cross product, addition, subtraction, triple product) and understand what's happening geometrically.
2. Write the equation for a line in the xy -plane and the equation for a plane (using normal vectors)
3. Find the angle between two planes
4. Find the angle between a plane and a line.
5. Find the distance between a point and a plane.
6. Write the parametric equation of a line.
7. Know the parametrizations of a circle, cycloid, and helix
8. Find the derivative of a vector function.
9. Find arc length
10. Find the unit tangent, unit normal, curvature, acceleration vectors, as well as the curvature and the equation for the osculating plane.
11. Sketch the graphs of a parabaloid, parabolic cylinder, cone, saddle.
12. Complete the square on a quadratic form.
13. Find the zero set of a quadratic form and find the regions in the plane in which the function is positive and negative.
14. Identify a quadratic form as (positive/negative) definite, (positive/negative) semidefinite, or indefinite.
15. Take partial derivatives of functions of several variables.
16. Find a linear approximation to a function at a point.

Problems:

1. Write the equation of the plane that passes through $A(0, 2, 5)$, $B(8, -4, 1)$ and $C(2, 9, 3)$.
2. Find the area of the triangle with vertices A , B and C , as in problem 1.
3. Find the distance between the point $Y(0, 3, 8)$ and the plane in problem 1. What is the location of Y in relation to the plane?
4. Write the equation of a plane that passes through $(0, 0, 0)$ and meets the plane in problem 1 at a right angle.
5. Write the equation of the line that passes through point Y (from problem 3) and is normal to the plane in problem 1.
6. Simplify $(\vec{a} + \vec{b}) \times (\vec{a} - \vec{b})$.
7. Find the velocity and acceleration vectors of a point traveling along the path $\vec{x}(t) = \langle \cos t, \sin t, 4t^2 \rangle$ at time $t = \pi/2$. What is the speed of the particle at that point?
8. Write the equation of the line tangent to the curve in the previous problem at the time $t = t_0$.
9. Draw the level sets of $f(x, y) = \sin x - y$.
10. Classify the quadratic form (i.e. name the shape of the graph and determine if it is definite, semidefinite, indefinite – with positive or negative as appropriate):
 $f(x, y) = -2x^2 + 4xy - 9y^2$
11. Complete the square on the quadratic form $f(x, y) = -2x^2 + 4xy - 9y^2$.
12. Find all partial derivatives of $f(x, y, z) = \frac{x \sin(yz)}{x^2 z} + z$.
13. Find a linear approximation to $f(x, y) = x^2 + xy + y^2$ at the point $(2, 1)$.