Below is a compilation of problems I have included in old exams corresponding to the material that covers our second Exam.

1. What’s your T.A.’s name, and what is your section?

2. If a particle is moving along a path described by \( \vec{r}(t) = \langle \cos t, \sin t, -\sqrt{8}t \rangle \), find the distance traveled by the particle from point \((1, 0, 0)\) to the point \((0, -1, -3\sqrt{2}\pi)\).

3. a) Find the curvature \( \kappa \) of the curve with position function \( \vec{r}(t) = (2t + 1)\vec{i} + t^2\vec{j} + t\vec{k} \) at \( t = \sqrt{5} \).

b) Find the Tangential and Normal components of the acceleration for this curve, also at \( t = \sqrt{5} \).

4. Find the rate of change of \( f(x, y) = xe^{x^2y} \) at \( P(1, \ln 2) \) in the direction of the vector \( \langle 1/2, -1/2 \rangle \).

5. Find \( \frac{\partial z}{\partial s} \) at the point \( (s, t) = (1, 1) \), if we know that \( z = xe^{y^2} - x\sin(xy) \) and \( x(s, t) = 3s + 3t \), \( y(s, t) = t - s \).– extra time? Find also \( \frac{\partial z}{\partial t} \).

6. The pressure \( P \), volume \( V \) and temperature \( T \) of a mole of an ideal gas are related by the equation \( PV = 8.31T \). Find the rate at which the pressure is changing when the temperature is 300K and increasing at a rate of 0.1K/s and the volume is 100L and increasing at a rate of 0.2L/s.

7. Find a vector in the direction of which \( f(x, y) = 4 + x^2 + 3y^2 \) decreases most rapidly at the point \((3, 4)\), and find the rate of change at this point in such direction.

8. Assuming that \( 3x^3 - \sin(yz) + x^2z - 3y^3\ln z = 3 \) defines \( z \) implicitly as a differentiable function of \( x \) and \( y \), find \( \frac{\partial z}{\partial x} \) and \( \frac{\partial z}{\partial y} \).

9. Find the equation of the tangent plane to the surface \( e^{xy} - xy^2 - \cos(xz) + z = 3 \) at the point \( P(\pi/4, 0, 2) \).

10. A closed right circular cylindrical can is to be built with material for the wall of 0.3in thick while the material for the top and bottom is 0.25in thick. If the dimensions inside the can are a depth of 20in and a diameter of 10in, approximate the amount of material needed for its construction. [You must use differentials for this problem!]

11. Find the linearization of the function \( f(x, y, z) = e^{xyz} \) at the point \( P(2, \ln 3, 1) \).