Key points for test 1: 10.5-6, 12.1-7

The list below might not be complete, but without knowing these things you will likely have problems doing the test.

Basic sing. var. calc. knowledge

- Differentiate basic functions (for example, $\sin x$, $\cos x$, e^x, x^p, $\ln x$), how to use product rule, quotient rule, chain rule.
- Compute equation of a line $y = ax + b$, given 2 points.
- Equations for parabolas, hyperbolas, ellipses.
- Dot product, cross product.
- Limits: **You are never allowed to go from "0/0", "∞/∞" etc. to the final answer**. Divide numerator and denominator by highest power, use l'Hospital's rule, etc.

Lines and surfaces (10.5/6)

- Parametric equation for a line (find point and direction), line of intersection between two planes (cross product).
- Equation for a plane (find point and normal direction).
- How to sketch cylinders (one variable missing) and quadric surfaces. You need to be able to show correct shape, orientation, and position. This includes "shifts".
- Find and identify cross-sections.

Differentiation (12.1-7)

- Domain and range of a function.
- Visualize functions of 2 variables: graphs and level curves (contour map), and how they are related. Easy ones (functions from Ch. 12) you should be able to sketch, difficult ones you should be able to recognize.
- Find whether a limit of a function of two variables does **not** exist (check different paths) or **does** exist (reduce to continuous function, squeeze theorem, polar coordinates).
- Identify where a function is continuous/discontinuous.
- Compute 1st and 2nd partial derivatives ("keeping other variables constant").
- Chain rule (Take care of the notation).

- Differentiate implicitly, using a given formula.
- Compute a gradient vector and unit vector.
- Compute a directional derivative (**Note the unit vector**).
- Relation between gradient vector and level curves (surfaces).
- Compute the minimum and maximum directional derivative and the corresponding directions.
- Compute tangent planes to **level surfaces** $f(x, y, z) = c$ and **graphs** $z = f(x, y)$.
- Compute a linearization ($L(x, y) = \cdots$) of a function.
- Estimating the change in f in a direction $\boldsymbol{u}$.
- Differentials and how to use them in approximations.
- Find critical points: on a region and on a boundary.
- Find local minima/maxima: Apply 2nd derivative test to each critical point.
- Find absolute minima and maxima. Compare function values at candidate points: critical points on interior of region, critical points on interior of boundary, boundary endpoints.
- Find absolute minima and maxima on parametrized curves.
- Apply the theory to applied (word) problems.

What NOT to know? Things that I didn't discuss during class.

- Proofs.
- Distance from a point to a line, distance from a point to a plane, angle between planes (Sec. 10.5).
- Level surfaces of functions of 3 variables (Sec. 12.1).
- δ-ϵ definition for limits and limits/continuity for functions of three variables (Sec. 12.2).
- Partial derivatives and continuity, Differentiability (Sec. 12.3).
- Error terms in linearizations (Sec. 12.6).