University of Colorado
Department of Mathematics

2005/2006 Semester 1 Math 2400 Calc 3 Discussion and practice, midterm 2

**There is no need to try all the problems listed. I was just asked to list some from the book that might be helpful. The HW problems are the most helpful.**

1. Material from book needed for exam:
   (a) Section 11.8 : Cylindrical and spherical coordinates, cylindrical coordinates, spherical coordinates, graphs of equations in cylindrical and spherical coordinates.
   Review homework and do problems pp. 845, 24, 32, 36, 37, 38, 49, 51.
   (b) Section 12.2, Functions of several variables: domain of the function, independent and dependent variables, graph of a function of two variables, contour curves of a graph of a function of two variables, level curves of a graph of a function of two variables, level surfaces of graphs and functions of three variables.
   Review homework and try problems pp. 860, 13, 14, 29, 44.
   (c) Section 12.3, limits and continuity: definition of limit of a function of two variables, definition of continuity of a function of two variables at a point, continuity and limit laws, limits of functions f(x,y) expressed as a fraction as (x,y) goes to (0,0) where numerator and denominator goes to 0, use of polar coordinates in the calculation of such limits, limits of functions of three or more variables.
   Review hw and try problems pp. 868, 10, 13, 31, 33, 38, 39, 54.
   (d) Section 12.4, Partial derivatives - definition and various notations for partial derivatives, instantaneous rates of change and partial derivatives, geometric interpretation of partial derivatives as slope of tangent lines to to x-curves and y-curves, tangent planes to surfaces, tangent planes to the graph of a function of two variables at a point, normal vector to the tangent plane at a point, partial derivatives of functions of three or more variables, higher-order partial derivatives, $f_{xy}(a,b) = f_{yx}(a,b)$ if $f_{xy}$ and $f_{yx}$ are continous on a circular disk centered at $(a,b)$.
   Review hw and try problems pp. 876, 5, 7, 13, 16, 23, 42, 44, 51.
   (e) Section 12.5 (first half) and Section 12.10 : Multivariable optimization problems: absolute - global max values and min values of functions, local max values and local min values of functions, finding local extrema - necessary conditions for local extrema (vanishing of both first-order partials if they exist);

Critical points of functions of two variables: the two variable second derivative test for $f$ at $(a, b)$ if $f_x(a, b) = 0 = f_y(a, b)$ and $f_x,\ f_y$ are continuous in a neighborhood of $(a, b)$, location of relative mins, relative maxs, and saddle points through this test, conditions under which the test fails. Note material pp. 933 - 935, "Proof of Theorem 1" not covered in exam.
Review hw and try problems pp. 888, 5, 7, 13, 15, 17, 22; pp. 935 2, 5, 9, 13, 16.

(f) Section 12.5 (second half): Multivariable optimization continued; finding global extrema, finding absolute max and absolute min of function that is continuous on and within a simple closed curve $\mathcal{C}$ (check values at critical points and fix max and min values along the boundary curve $\mathcal{C}$), highest and lowest points of surfaces, applied max-min problems of several variables, functions of three or more variables.
Review hw and try problems pp. 889, 28, 37, 40, 43.

(g) Section 12.6 : Increments and linear approximation; the increment, the differential, the formula for linear approximation in two variables (Eq (8) p. 892), increments and differentials for functions of three or more variables, linear approximation and differentiability, the gradient vector for a real-valued function of a vector variable, formula for linear approximation in vector form, definition of differentiability of a function of several variables at a point.
Review hw and try problems pp. 897, 5, 9, 27, 28, 30, 36.

(h) Section 12.7 : The multivariable chain rule; the version of the chain rule in Theorem 1 p. 899, functions of several independent variables, and the general chain rule in Theorem 2, implicit partial differentiation and the implicit function theorem.
Review hw and try problems pp. 906, 3, 5, 8, 19, 20, 29, 31, 41.

2. Try some problems from the miscellaneous problems sections of the book, pp. 938 and following, nos. 1, 2, 6, 8, 15, 41, 43, 44, 45, 47.