Calculus Topics

Below is a list of calculus topics that will be covered during math camp at Harris, Summer 2015. Links to some resources are provided as a guide but are not exhaustive.

OLD EXAMS
1. We are also sending the 2014 calculus exam and its solution.

2. You can also look at more exams at http://math.uchicago.edu/~boller/HarrisMathCamp/. However, the subject material has changed slightly. For 2015, there will be NO questions on the following topics even though they will be covered during class:
   1. Asymptotes
   2. Delta-epsilon definition of limits and related problems (for e.g., Q. 2(a) 2011, Q1.(a) 2010, Q1.(a) 2009; Q1.(a) 2008).

I. SINGLE VARIABLE CALCULUS

Functions, Limits & Continuity
Topics:
- Functions include absolute value functions, rational functions, polynomials, exponential, logarithmic functions (the laws of logs).
- Domain and Range of Functions.
- How to Compute Limits.
- Definition of Continuity.

Example Assessment:
- Determine the domain of different types of functions.
- Compute limits: includes the different algebra tricks needed to take limits.

Some Resources:
https://www.khanacademy.org/math/algebra2/functions_and_graphs/domain_range/e/domain_of_a_function


Derivatives
Topics:
- Rates, Slopes and the Definition of the Derivative
- Definition of a derivative and Differentiability.
- Derivative Theorems (includes Product Rule, Chain Rule).
- First Derivative Test; Second Derivative Test
- Global and local minimums and maximums (1 variable, local & global min max).
- Analysis of Functions: Second derivatives, Concavity and Inflection Points.

Example Assessment:
- Compute a derivative using the definition of limits.
- Take a derivative of different functions without using the definition of a limit (power rule).
- Use the product rule, quotient rule, chain rule when taking derivatives.
- Compute second derivatives of a variety of functions.
- Identify critical points of a function.
- Identify local and global minima and maxima.
- Identify inflection points.
- Determine whether functions are concave up or concave down and over what intervals.
- Make an accurate graph of a function.

Some Resources:


Integration - Area and the Definite Integral
Topics:
- Definition of Integration.
- How to compute integrals.
- Antiderivatives and the Fundamental Theorem of Calculus.

Example Assessment:
• Computing integrals of relatively easy functions.

Some links:

II. MULTIVARIABLE CALCULUS

Functions of several variables
Topics:
• Explanation of functions of several variables.
• Examples.

Levels Sets of Functions
Topics:
• Explanation of level sets of functions.
• Examples.

Some Resources:
http://mathinsight.org/level_sets

Partial Derivatives
Topics:
• Partial Derivatives.
• Implicit differentiation.

Some Resources:

Example Assessment:
• Compute partial derivatives and the gradient.
• Find the derivative using implicit differentiation.

Gradients & Lagrange Multiplier
Topics:
• Computing the gradient.
• Lagrange Multipliers.
• Constrained Optimization using the Lagrange multiplier.

Example Assessment:
• Solve a problem of constrained optimization using the Lagrange multiplier.

Some Resources:
http://freevideolectures.com/Course/2300/Multivariable-Calculus/13#