MIDTERM 1 STUDY GUIDE

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Midterm 1 takes place on **Friday, July 1st, at 11:10 am in our usual classroom**. However, come early, because we might get started earlier than 11:10 am (to give you extra time) and because we might move to the room next to ours (289 Cory), to give you extra space. The midterm counts for 20 $\%$ of your grade, and covers sections 1.1, 1.3, 1.5, 1.6, 2.2, 2.3, 2.5, and 2.6. This is the study guide for the exam, and contains **everything** you'll need to know for the exam. It has a lot of problems, but that's mainly to give you extra practice in case you need it, so you don't have to do all of them. The material in **bold** I feel is more important than the rest, so make sure to spend more time on those ones than on the others.

Note: Make sure to do exercises 65, 66, and 67 in section 1.6, because you are guaranteed to have a similar problem on the exam!

Note: 1.3.4 means 'Problem 4 in section 1.3'

Know how to:

1. Chapter 1: Functions and Models

- Determine whether a given graph is the graph of a function (1.1.5, 1.1.6)
- Given the graph of a function, determine its domain and range (1.1.6, 1.1.7)
- **Find the domain of a function, given a formula** (1.1.27, 1.1.28, 1.1.30, 1.1.32, 1.5.15, 1.5.16, 1.6.53(a))
- **Determine whether a function is even, odd, or neither, given a formula** (1.1.65, 1.1.66, 1.1.69)
- **Explain how to obtain a new function from a given function** (1.3.10, 1.3.11, 1.3.13, 1.3.15, 1.3.18, 1.5.7, 1.5.9, 1.5.11, 1.6.45, as well as $y = \cos(2x + 3)$, $y = 1 - 2x^2$, $y = \tan(-x + 1)$)
  Note: On the exam, I will not ask you to actually graph the new function (in order to save you time), so a typical question might be: 'Explain in words how to obtain the graph of $y = 2x^2 + 1$ from the graph of $y = x^2$'. And remember that for vertical transformations, the shift comes **last**, and for horizontal transformations, the shift comes **first**.

- Given f and g, find composition of functions, i.e. $f \circ g$, $g \circ f$, $f \circ f$, etc. (1.3.31, 1.1.33, 1.3.36)
- Given f, g, h, find $f \circ g \circ h$ (1.3.37, 1.3.39, 1.3.40)
- Express a function in the form $f \circ g$ (1.3.41, 1.3.42, 1.3.45, 1.3.46)
- Given a graph, determine whether a function is one-to-one (1.6.5, 1.6.6)
- Given a formula, determine whether a function is one-to-one (1.6.10, 1.6.11, 1.6.12)

Date: Friday, June 24th, 2011.

- Find the formula for the inverse of a function (1.6.21, 1.6.23, 1.6.24, 1.6.25)
- Solve equations and inequalities involving e^x and $\ln(x)$ (1.6.47, 1.6.48, 1.6.51, 1.6.52)
- **Simplify expressions involving inverse trig functions, using the triangle method (1.6.65, 1.6.66, 1.6.67)**
  Note: You can also solve those problems using formulas like $\cos^2(x)+\sin^2(x) = 1$ and $1 + \tan^2(x) = \sec^2(x)$, but you'd have to justify why your final answer is positive. Also, **make sure to show your steps!**

2. Chapter 2: Limits and Derivatives

- Given a graph, find a given limit if it exists or explain why it does not exist. Also, find the vertical asymptotes. (2.2.4, 2.2.5, 2.2.6, 2.2.7, 2.2.8, 2.2.9)
- **Find limits of a function:**
  - Step 1: Just by plugging in (2.3.3, 2.3.6, 2.3.9)
  - Step 2: By noticing that it's of the form $\frac{1}{0^+} = \infty$ or $\frac{1}{0^-} = -\infty$ (2.2.25, 2.2.28, 2.2.29)
  - Step 3: By factoring out the numerator and the denominator and simplifying (2.3.12, 2.3.13, 2.3.14, 2.3.15, 2.3.16, 2.3.17, 2.3.26)
  - Step 4: Whenever there is a square root, by multiplying numerator and denominator by the conjugate form (2.3.21, 2.3.23, 2.3.29, 2.3.30, 2.3.60)
  - Step 5: By using the squeeze theorem (2.3.35, 2.3.37, 2.3.38)
  - Step 6: By calculating $\lim_{x\to a^-}$ and $\lim_{x\to a^+}$ and by noticing that they're equal or not (2.3.39, 2.3.40, 2.3.42, 2.3.46(a)(b), 2.3.47(a)(b))

  Note: If you need more practice, try the following set of problems: 2.3.22, 2.3.8, 2.3.11, 2.3.12, 2.3.36
- Given a graph, say where a function is continuous, and state the types of discontinuities (2.5.3, 2.5.4)
- Given a formula, say where a function is continuous (2.5.27, 2.5.37, 2.5.39)
- Evaluate limits using continuity (2.5.33, 2.5.34. 2.6.34, 2.6.36)
- **Use the intermediate value theorem to show that a given equation has at least one solution** (2.5.47, 2.5.48, 2.5.49, 2.5.51(a), 2.5.52(a))
  Note: Make sure to show your steps and use the words 'continuous' and 'IVT'. Also, I might not give you any intervals, sometimes you'd have to guess it!
- Given a graph, find limits at ∞ as well as equations of the horizontal asymptotes (2.6.3, 2.6.4)
- **Find limits at infinity of a function:**
  - Step 1: Just by plugging in (2.6.15, 2.6.30)
  - Step 2: By factoring out the highest power out of an expression (2.6.31)
  - Step 3: By factoring out the highest power of the numerator and the denominator (2.6.16, 2.6.17, 2.6.19, 2.6.21, 2.6.33)
  - Step 4: By factoring out the highest power of x out of a square root (2.6.22, 2.6.23, 2.6.24, also try those out with $-\infty$ replacing ∞, and vice-versa) **Note:** Remember that $\sqrt{x^2} = |x| = x$ (if $x > 0$) and $= -x$ (if $x < 0$)
  - Step 5: By using the conjugate form, making sure to do Step 4 first (2.6.25, 2.6.26, 2.6.27)
  - Step 6: By using the squeeze theorem (2.6.35, 2.6.53(a), 2.6.57)

  Note: If you need more practice, try the following set of problems: 2.6.30, 2.6.29, 2.6.20, 2.6.37(c)