Below is a list of topics which will be covered on the first midterm. This list is not necessarily inclusive.

- Basic Functions, e.g. power, rational, radical, exponential, trigonometric, logarithmic functions, and their graphs, domains, ranges, etc.
- Transformations of basic functions, and how this alters domain, range, etc.
- One-to-one functions, inverses. Graphs, domains, ranges, thereof.
- Limits of Functions, including one-sided limits, existence of limits, limits at ±∞.
- Limit Laws
- Continuity of Functions
- Definition of the derivative, the derivative function, higher-order derivatives.
- Differentiability
- Derivative Laws: derivative of constant, power function, trig function, product rule, quotient rule.

**Note:** The precise definition of a limit (i.e. Section 1.4) will **not** be covered on the exam.

Several sample exams and exams from previous years as well as their solutions are listed on the website (http://math.rice.edu/~bf2/math101.html). I must warn you, however, that these problems are not inclusive as to what will be included on your exam, nor is everything on these exam stuff that you will see. In previous years, the classes did not cover the items 1-3 above in as much detail and therefore were able to cover much more with regards to derivation rules before their first exam. Please keep this in mind when you work through these tests so that you do not waste your time on problems which you will not encounter. Below is a list of problems which I hope will serve as a supplement to what these exams do not cover.

**Warning:** You have been slightly bombarded now with practice problems and sample exams. Do not feel like you have to do every single problem on every single practice exam. Use common sense and spend your study time wisely. Use these to gauge your understanding, and if these problems prove difficult, you can refer to the book for even MORE sample problems.

Finally, **Good luck!** I’m sure you’ll all do quite well. Your enthusiasm and relative wakefulness have shown that you are so far engaged and attentive. Do not lose faith. It is more important to have a good sleep and breakfast and come to the exam room calmly and confidently than to spend those last minutes cramming and stressing yourself out.
1. Let
\[ f(x) = x^2 - 2x + 3 \]
(a) Using transformations, graph \( f(x) \).
(b) Find the domain and range of the function.
(c) What is the largest interval over which the function \( f(x) \) is one-to-one?
(d) What is the inverse of \( f(x) \) over this interval?

2. Use transformations to sketch the graph of the following functions. State the domain and range of each. Is the function one-to-one? If so, find the inverse. If not, state what the largest domain over which the function is one-to-one. Then, find its inverse. In either case, state the domain and range of the inverse function.

(a) \[ f(x) = -\sin(2x) + 2 \]
(b) \[ g(x) = \ln(2x) - 4 \]
(c) \[ h(x) = 2\sqrt{x + 1} \]

3. Let \( f(x) \) be the function defined by
\[ f(x) = \begin{cases} 
-\sqrt{-x - 2}, & \text{if } x < -2, \\
5 - x, & \text{if } -2 \leq x < 1, \\
(x - 3)^2, & \text{if } x > 1.
\end{cases} \]
(a) Evaluate each limit, if it exists.
   i. \[ \lim_{x \to -2^+} f(x) \]
   ii. \[ \lim_{x \to -2^-} f(x) \]
   iii. \[ \lim_{x \to -2} f(x) \]
   iv. \[ \lim_{x \to 1^+} f(x) \]
   v. \[ \lim_{x \to 1^-} f(x) \]
   vi. \[ \lim_{x \to 1} f(x) \]
(b) Where is \( f(x) \) discontinuous? On what intervals is \( f(x) \) continuous?
(c) Sketch the graph of \( f(x) \).
(d) On what interval(s) is \( f(x) \) differentiable? Is \( f(x) \) differentiable at \( x = -2 \)? Why or why not?
4. Show the following functions are continuous on their domains.

(a) \[ h(x) = x^3 e^{\cos(x)} \]

(b) \[ g(x) = \frac{\sqrt{x^2 - 4}}{x^2 - 3} \]

5. Determine if the following functions are differentiable at \( x = 1 \).

(a) \[ f_1(x) = |x - 1| \]

(b) \[ f_2(x) = (x - 1)^{-1/2} \]

(c) \[ f_3(x) = (x - 1)^{1/2} \]

(d) \[ f_4(x) = (x - 1)^{4/3} \]