- Please make sure that you can solve all of the problems from the course calendar. If you feel you need additional practice, solve problems in Stewart that are similar to the assigned problems.

  If you have not already done so, please start a notebook containing your solutions to all homework problems.

- Please be prepared to state clearly and correctly the main results that are used in the homework problems. It is particularly important to know the complete statement of L'Hospital's rule. (Mis)-applications of L'Hospital's rule often prevent me from awarding as many points as I would like on exams.

  Also, note that there are a number of problems devoted to deriving the derivatives of the inverse trigonometric functions. (See §6.1 #37, 38, §6.6 #27, 29). As I indicated in class, you should not be surprised to see such a problem on the exam.

- A schedule for tutoring in the Mathskeller, CB065, is available at www.mathskeller.org and then the link for Tutors. A schedule of office hours in Mathskeller may found on the link for Instructors. In addition, you should feel free to use the Mathskeller for studying if you have a free hour between classes.

- The notebook of handouts and solutions to selected problems is in the math library in the basement of POT.

- Assignments are available on the web from a link at http://www.math.uky.edu/∼rbrown/courses

- Please know[1] integration formulae #1–17 from the table of integrals inside the back cover of our textbook. You should also know the corresponding differentiation formulae.

- Trigonometry review. Below are some facts every mathematics student should know. The addition formulae will not be heavily used until the second test.

  1. The definitions of sin and cos using the unit circle.
  2. The identities $\sin(-x) = -\sin x$ and $\cos x = \cos(-x)$ which tell us that sin is an odd function and cos is an even function.
  3. The definitions of tan, cot, sec and csc in terms of sin and cos.
  4. The trigonometric functions for the special angles 0, $\pi/6$, $\pi/4$, $\pi/3$, and any angle obtained by adding a multiple of $\pi/2$.

[1] "Know" means that you should memorize the formula and you should know why the formula is true.

5. The Pythagorean identity $\sin^2 x + \cos^2 x = 1$ and its use in deriving the identities $1 + \tan^2 x = \sec^2 x$ and $1 + \cot^2 x = \csc^2 x$.
6. The addition formulae for sin and cos:

$$\sin(x + y) = \sin x\, \cos y + \cos x\, \sin y$$

and

$$\cos(x + y) = \cos x\, \cos y - \sin x\, \sin y.$$

7. Consequences of the addition formulae such as the subtraction and the double-angle formulae for sin and cos and the co-function identities: $f(\pi/2 - x) = cof(x)$ where f may be sin, tan and sec.

Sample exams

1. Compute the following derivatives.
   (a) $\dfrac{d}{dx} e^{x^2}$
   (b) $\dfrac{d}{dx} \dfrac{\ln x}{1 + x^2}$
   (c) $\dfrac{d^2}{dx^2} xe^{2x}$
2. Evaluate the following definite and indefinite integrals.
   (a) $\displaystyle\int x \sin x \, dx$
   (b) $\displaystyle\int \frac{3}{1 + x^2}\, dx$
   (c) $\displaystyle\int_2^4 \frac{x}{x^2 + 1}\, dx$
   (d) $\displaystyle\int \frac{x + 1}{\sqrt{1 - x^2}}\, dx$
3. (a) Find the following limits.
      i. $\displaystyle\lim_{x \to 0} \frac{\tan(5x)}{x}$
      ii. $\displaystyle\lim_{x \to \infty} \frac{e^x}{x^2 + 1}$.
      iii. $\displaystyle\lim_{x \to 1} \frac{e^x}{x^2 + 1}$.

   (b) Carefully state the version of l'Hopital's rule that may be used to find the limit in part (a)(i).

4. Find the values of λ for which $y(x) = e^{\lambda x}$ satisfies the equation

$$y'' - 2y' - 3y = 0.$$

5. A population of critters grows exponentially. At time $t = 0$, there are 400 critters and after 3 hours, there are 500 critters.

   (a) Find an expression for the population after t hours.

   (b) Find the number of critters after 5 hours.

   (c) When will the population reach 20,000?

6. Simplify the following expressions to write them without trigonometric functions. Please explain your reasoning.

   (a) $\sin(\cos^{-1}(4/5))$

   (b) $\cos^{-1}(\cos(7\pi/4))$

   (c) $\tan(\sin^{-1}(x))$

7. There are numbers a and b so that

$$\int x^{10} e^{2x}\, dx = a x^{10} e^{2x} + b \int x^9 e^x\, dx.$$

   (a) Integrate by parts to establish this formula.

   (b) Give the values of a and b.

   `We have not studied integration by parts, yet.  So you do not need to review this question.`

8. Let $f(x) = \cos(x)$ with domain $[-\pi, 0]$ and let $g(x)$ be the inverse function.

   (a) What are the domain and range of g?

   (b) What is $g(0)$?

   (c) Sketch the graphs of f and g.

   (d) Derive the formula for the derivative of g using the formula for the derivative of inverse functions.

1. Suppose $f(x) = \frac{1}{2}x^3 + x + 1$.

   (a) Sketch $f(x)$.

   (b) Sketch $f^{-1}(x)$.

   (c) Find $f^{-1}(\frac{5}{2})$. Hint: This is easily done by inspection.

   (d) Find $f^{-1\prime}(\frac{5}{2})$.

2. Compute the following derivatives.
   (a) $D_x x^2 e^x$.
   (b) $D_x \dfrac{e^x + 1}{e^x - 1}$
   (c) $D_x \ln(x^{2x})$
   (d) $D_x \ln(\cos x)$
   (e) $D_x \tan^{-1}(2x)$

3. Compute the following integrals.
   (a) $\displaystyle\int_2^3 \frac{x+1}{x}\, dx$
   (b) $\displaystyle\int \frac{e^x}{e^x + 1}\, dx$
   (c) $\displaystyle\int_0^2 \frac{x}{1+x^4}\, dx$

4. Give exact values for the following. You may use your calculator to check your answer, but you must explain the reasoning for computing these quantities without a calculator.
   (a) $\sin(\sin^{-1}(1/4))$
   (b) $\sin(\cos^{-1}(-1/3))$
   (c) $\cos(2\sin^{-1}(1/5))$

Do exactly one of the following problems. Indicate clearly which problem is to be graded.

5. (a) Give the definition of $\ln x$.
   (b) If $a > 0$ and $b > 0$, prove that
   $$\ln(ab) = \ln a + \ln b.$$

6. Let $f(x)$ be the inverse function for $\cos x$ on the interval $[0, \pi]$.
   (a) Differentiate the equation
   $$\cos(f(x)) = x$$
   and express $f'(x)$ in terms of f and a trigonometric function.
   (b) Use trigonometric identities to simplify your answer from part a) and express $f'(x)$ only in terms of x.