# Math 143 First Midterm Review Sheet

**9/28/2017**

Here is an itemized list of the material that the first midterm is based upon. Make sure that you study them carefully. For each topic, you can review the examples that I gave in lecture, the worked out examples in the book, past quizzes, and the homework problems and solutions available on WebAssign.

- The fundamental theorem of calculus: If $F$ is any antiderivative of $f$, then
$$\int_a^b f(x)\,dx = F(b) - F(a).$$
- Useful integration formulas to remember:
$$\int x^n\,dx = \frac{1}{n+1}\,x^{n+1} + C \quad (n \neq -1)$$
$$\int \frac{1}{x}\,dx = \ln|x| + C$$
$$\int \sin x\,dx = -\cos x + C$$
$$\int \cos x\,dx = \sin x + C$$
$$\int \sec^2 x\,dx = \tan x + C$$
$$\int \sec x \tan x\,dx = \sec x + C$$
$$\int e^x\,dx = e^x + C$$
$$\int \ln x\,dx = x\ln x - x + C$$
$$\int \frac{1}{\sqrt{a^2 - x^2}}\,dx = \sin^{-1}\left(\frac{x}{a}\right) + C$$
$$\int \frac{1}{a^2 + x^2}\,dx = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$$
- The substitution method
- Integration by parts
- Trigonometric integrals and substitutions
- Partial fractions and integration of rational functions
- Approximate integration, Riemann sums, left, right, trapezoid, midpoint and Simpson sums
- L'Hôpital's rule, application in finding limits of indeterminate forms

**Practice Problems**

1. Find the area under the curve $y = \dfrac{\sin\sqrt{x}}{\sqrt{x}}$ between $x = 0$ and $x = \pi^2$.

2. Find the following integrals (in each case you need to decide which method works best):

- $\displaystyle\int x\, e^{3x}\, dx$
- $\displaystyle\int \sin^2 x\, dx$
- $\displaystyle\int_0^{\sqrt{3}} \sqrt{3 - x^2}\, dx$
- $\displaystyle\int \frac{5x - 2}{2x^2 - x - 1}\, dx$

3. Use your calculator program to find the left, right, trapezoid, midpoint, and Simpson approximations for the integral

$$\int_0^3 e^{-x^2}\, dx$$

with $n = 10$ and then $n = 50$ subdivisions. Based on your results, estimate the value of this integral to 4 decimal places.

4. Use L'Hôpital's rule to find

$$\lim_{x\to 0} \frac{x - \tan^{-1}(x)}{x^3} \qquad \text{and} \qquad \lim_{x\to 0} (\cos x)^{1/x^2}.$$