# Math 141- Review Sheet for 1st Exam

The first exam is Tuesday February 17 and will cover Chapters 5.6, 6.1-6.6, 7.1-7.6 As a good first step make sure you understand all the quiz problems and homework problems! This sheet is designed to help you organize your studying, not to be exhaustive.

**Theory to Know:**

- Mean value theorem for integrals.

**Skills you should have:**

- Use u-substitution to reduce an integral to one you already know, including definite integrals with changing the limits.
- Compute area between two curves, including finding the points of intersection and integrating with respect to y if necessary, or dividing the region into two pieces if necessary..
- Compute volumes of revolution by the disc, washer and cylindrical shell methods.
- Compute work done using (4) on p.439.
- Compute the average value of a function on [a,b] and find c('s) satisfying the mean value theorem for integrals.
- Know the basic integration formulas on page 452.
- Apply one or more techniques to evaluate a given antiderivative, including integration by parts, using trig identities to compute trigonometric integrals, doing inverse substitutions, and the method of partial fractions. There may be a problem using integration by tables, the table will be provided.

Sample application of integration problems:

1. Find the area enclosed by the curves $x=y^2-4y$ and $x=2y-y^2$.

2. Find the area enclosed by the curves $y=|x|$ and $y=x^2-2$.

3. Consider the region enclosed by the curves $y=x^2$ and $y=\sqrt{x}$. Find the volume obtained by rotating this region around the line $y=2$. Repeat for the line $x=1$.

4. p. 436 #11, 12

5. Let $f(x)=e^x$ on [0,3]. Find the average value of f(x) on [0,3]. Then find a c which satisfies the mean value theorem for integrals.

See the attached sheet for integration problems.

PRACTICE PROBLEMS ALSO ON WEBASSIGN!

Here are some useful trig identities you should know, together with all the integrals on p.452 plus the derivatives of all the trig functions (p. 193). You may be told which method of integration to use, but not always so review the discussion in Section 7.5. Also there may be a problem using the tables.

$$\sin^2 x + \cos^2 x = 1, \quad \tan^2 x + 1 = \sec^2 x, \quad 1 + \cot^2 x = \csc^2 x.$$

$$\sin^2 x = \frac{1 - \cos(2x)}{2}, \quad \cos^2 x = \frac{1 + \cos(2x)}{2}, \quad \sin(2x) = 2 \sin x \cos x.$$

**Practice integrals for exam 1:**

1. $\int \frac{x}{2x^2+5x+2} dx$
2. $\int \sin^3 x \cos^3 x dx.$
3. $\int \frac{\ln(3+x^2)}{3+x^2} dx$
4. $\int (\ln x)^2 dx.$
5. $\int \sec^3 x \tan^3 x dx.$
6. $\int \frac{x^2}{(x^2+1)(x^2-4)}.$
7. $\int \frac{x^2}{x-4}.$
8. $\int \frac{dx}{x^2\sqrt{4-x^2}}.$
9. $\int \frac{x^2}{\sqrt[3]{6x^3+1}} dx$
10. $\int x \sin^{-1} x dx.$
11. $\int \frac{1}{\sqrt{4y^2-4y-3}} dy$
12. $\int \frac{\tan^{-1} x}{x^2}$. Hint: start with integration by parts, $u = \tan^{-1} x$.
13. $\int \frac{x^2+1}{(x-1)^3} dx$
14. $\int \frac{e^{2x}}{1+e^x} dx.$
15. $\int \cos^2 x \tan^3 x dx.$
16. $$\int_0^{3\sqrt{3}/2} \frac{x^3}{(4x^2+9)^{3/2}} dx.$$