My Office Hours: M & W 2:30–4:00, Tu 2:00–3:30, & F 1:30–2:30 or by appointment. **Math Intern:** Sun: 2:00–5:00, 7:00–10pm; Mon thru Thu: 3:00–5:30 and 7:00–10:30pm in Lansing 310. Website: `http://math.hws.edu/~mitchell/Math131F15/index.html`.

☕ *Practice*

We will start on trig integrals today. Make sure you do lots of practice. Read Section 7.3. Read the **Online Notes**. I will not require you to memorize all of these formulas.

1. Today we complete integration by parts is an important technique the greatly enlarges the number of integrals that you can do.

(*a*) Standard parts at least twice: Try page 520 #23, 25, 27 .

(*b*) Definite integrals with parts: Try page 520 #33, 35, 37.

(*c*) Applications with parts: Try page 521 #39 and 41.

Reference: Summary of Trig Integrals

2. Degree 2 Sine and Cosine Functions. One simple way to do these is to use trig identities. Make sure you know these.

(*a*) $\int \cos^2 u\,du = \int \frac{1}{2} + \frac{1}{2}\cos 2u\,du = \frac{1}{2}u + \frac{1}{4}\sin 2u + c.$

(*b*) $\int \sin^2 u\,du = \int \frac{1}{2} - \frac{1}{2}\cos 2u\,du = \frac{1}{2}u - \frac{1}{4}\sin 2u + c.$

3. Low Powers of the Tangent and Secant Functions. These are done with simple identities. Make sure you know these.

(*a*) $\int \tan u\,du = \ln|\sec u| + c.$

(*b*) $\int \tan^2 u\,du = \int \sec^2 u - 1\,du = \tan u - u + c.$

(*c*) $\int \sec u\,du = \ln|\sec u + \tan u| + c.$

(*d*) $\int \sec^2 u\,du = \tan u + c.$

Reduction Formulas for Large Powers.

These are verified using integration by parts. Repeated application may be necessary.

(1) $\int \cos^n u\,du = \frac{1}{n}\cos^{n-1} u \sin u + \frac{n-1}{n}\int \cos^{n-2} u\,du$

(2) $\int \sin^n u\,du = -\frac{1}{n}\sin^{n-1} u \cos u + \frac{n-1}{n}\int \sin^{n-2} u\,du$

(3) $\int \tan^n u\,du = \frac{1}{n-1}\tan^{n-1} u - \int \tan^{n-2} u\,du$

(4) $\int \sec^n u\,du = \frac{1}{n-1}\sec^{n-2} u \tan u + \frac{n-2}{n-1}\int \sec^{n-2} u\,du$

Hand In: Spot Check

0. WeBWorK set Day21 due Thursday night. Start early.

1. $\int e^x \cos(7x)\,dx$. Try to avoid fractions until the very end. Same as WeBWorK Day 21, Problem 4. Do them together.

2. Page 520 #36. Use a u-substitution first and last. (Messy answer, decimal is ok.)

3. Page 521 #40. Use shells.

4. Page 521 #52. Read the instructions.

5. Page 521 #54. Your choice, either (a) or (b).

6. (*a*) Review: Determine $\int \sin^2(3x)\,dx$.

(*b*) New: Use a reduction formula formula listed above (also see page 526) to determine $\int \cos^4 x\,dx$. Same as WeBWorK Day 21, Problem 9. Do them together.

7. Extra Credit: $\int \sin\sqrt{x}\,dx$. Hint: First use a substitution and then use parts.

8. Extra Credit: Find the volume when the region bounded by $f(x) = x\ln x$ and the x-axis on the interval $[1, e^2]$ revolved about the x-axis.

Classwork—Not handed in

1. Integral Mix Up: Before working these out, go through and classify each by the technique that you think will apply: substitution, parts, parts twice, or mental adjustment-ordinary methods. Which can't you do yet? The **answers** are below. The final answers are online in the Class Notes for Day 20 if you work any out.

(*a*) $\int 2e^{-\pi x}\,dx$ (*b*) $\int \cos x e^{\sin x}\,dx$ (*c*) $\int e^x \cos x\,dx$

(*d*) $\int x\cos x\,dx$ (*e*) $\int \cos(2\pi x)\,dx$ (*f*) $\int \frac{\ln x}{x}\,dx$

(*g*) $\int (x^2+1)e^{x^3+3x}\,dx$ (*h*) $\int (x^2+1)e^x\,dx$ (*i*) $\int x^2 \ln x\,dx$

(*j*) $\int \sec^2(2x)\,dx$ (*k*) $\int \frac{x}{25+x^2}\,dx$ (*l*) $\int \frac{1}{1+25x^2}\,dx$

(*m*) $\int \frac{1}{\sqrt{1-9x^2}}\,dx$ (*n*) $\int \frac{\cos x}{\sqrt{1-\sin^2 x}}\,dx$ (*o*) $\int \frac{\sin^{-1} x}{\sqrt{1-x^2}}\,dx$