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*

For the next few weeks we will be considering a variety of integration techniques. Unless you do **lots of practice** before and after every class, this material will rapidly become very confusing. Do not fall behind! I will be giving you several short hand in assignments and WeBWorK assignments to keep you caught up.

Today we continue developing methods of integration. Begin by **reviewing the material in Section 7.1** which covers basics you already know. (You may ignore formulas 6, 8, and 13 in the list on page 511.) Add to this list the new ones we discussed today: If $b > 0$, then

$$\int b^x\,dx = \frac{1}{\ln b} b^x + c \qquad \text{and} \qquad \int b^u\,du = \frac{1}{\ln b} b^u + c,$$

1. The first new technique we are exploring is integration by parts which reverses the product rule. **Read 7.2** and the online notes. (Review Section 7.1.) Integration by parts is an important technique the greatly enlarges the number of integrals that you can do. Not all are by parts.

(*a*) Try page 520 #1, 5, 7, 15, 17, 19, 21, 23, 27, 29[twice!, see Example 3] and 25. The last few are somewhat harder:

(*b*) Try page 521 #39 by shells.

2. Integral Mix Up: Before working these out, go through and classify each by the technique that you think will apply: substitution, parts, parts twice (See Example 3 in the text and class notes), or ordinary methods. Which can't you do yet? The **answers** are on the back.

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

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

Hand In: Spot Check. ☞ *Continues on the back.*

In some of these problems you will need to use integration by parts twice.

0. WeBWorK set `Day20` due late Monday night. Start early.

1. From the list above: #2 (f), (h), and (m)

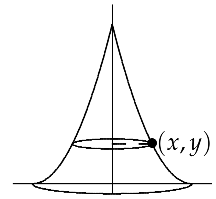
2. (*a*) Page 520 #12 (Similar to WeBWorK Problem 4.)

(*b*) Page 520 #22 (This combines two techniques, be patient and careful)

(*c*) Page 520 #14

(*d*) Page 520 #18.

(*e*) Page 520 #26. Remember $\ln^2 x$ means $(\ln x)^2$.



3. (*a*) A tank is formed by rotating the region in the first quadrant enclosed by $y = (x-2)^2$, the y-axis, and the x-axis about the y-axis as shown. Set up the integral for the work done pumping oil (density 60 lbs/ft^3) to the top of the tank.

(*b*) Set up the work integral if the oil was pumped to a height 2 feet above the top of the tank?

(*c*) Set up the work integral for pumping the oil to the tank top if there is only 1 foot of oil in the tank.

4. XC: $\displaystyle\int \frac{xe^x}{(x+1)^2}\,dx$. Use $dv = \frac{1}{(x+1)^2}\,dx$

2. Some Answers to the Mix-Up Problem: (All "$+c$".)

(*a*) $\dfrac{-2e^{-\pi x}}{\pi}$	(*b*) $e^{\sin x}$	(*c*) $\frac{1}{2}e^x(\cos x + \sin x)$
(*d*) $x \sin x + \cos x$	(*e*) $\frac{1}{2\pi}\sin(2\pi x)$	(*f*) HW
(*g*) $\frac{1}{3}e^{x^3+3x}$	(*h*) HW	(*i*) $\frac{1}{3}x^3\left(\ln x - \frac{1}{3}\right)$
(*j*) $\frac{1}{2}\tan(2x)$	(*k*) $\frac{1}{2}\ln(25 + x^2)$	(*l*) $\frac{1}{5}\arctan\frac{x}{5}$
(*m*) HW	(*n*) $\arcsin(\sin x)$	(*o*) $\frac{1}{2}(\arcsin x)^2$