Erect, arched in disdain, 
the integrals drift from left 
across white windless pages 
to the right, 
serene as swans.

Tall 
beautiful seen from afar 
on the wavering water, each 
curves with the balanced severity 
of a fine tool weighed in the palm.

Gaining energy now, they 
break into a canter–stallions 
bobbing the great crests of their manes. 
No one suspects their power 
who has not seen them rampage.

Like bulldozers, they build 
by adding 
dirt to dirt to stumps added 
to boulders to broken glass added 
to live trees by the roots added 
to hillsides, to whole 
housing developments 
that roll, foaming before them, 
the tumbling end of a broken wave 
in one mangled sum: dandelions, old 
beer-cans and broken 
windows–gravestones all 
rrolled into one.

Yes, with the use of tables 
integration is as easy as that: 
the mere squeeze of a trigger, no 
second thought. The swans 
cannot feel the pain 
it happens so fast.

-Jonathan Holden
For Tuesday workshop, get started on homework.

1. (Thursday Workshop) Choose two or three of the following definite integrals and approximate them using rectangles. Make one estimate that is smaller than the actual integral and one that is larger. Use enough rectangles to guarantee at least one decimal place of accuracy. Guess the actual value (if you already know it, pretend you don’t.) At the end of workshop, try to combine everyone’s information to draw some conclusions.

   • $\int_0^2 x^2 \, dx$
   • $\int_0^4 x^2 \, dx$
   • $\int_0^\pi/4 \cos(x) \, dx$
   • $\int_0^\pi/6 \cos(x) \, dx$
   • $\int_0^\pi/3 \cos(x) \, dx$
   • $\int_0^\pi/2 \cos(x) \, dx$
   • $\int_1^2 \frac{1}{x} \, dx$
   • $\int_1^3 \frac{1}{x} \, dx$
   • $\int_1^4 \frac{1}{x} \, dx$
   • $\int_0^1 e^x \, dx$
   • $\int_0^2 e^x \, dx$
   • $\int_0^3 e^x \, dx$

2. Section 5.3, problems 5, 6, 22, 37, 41, 52, 55, 64, 66.

3. Section 8.3, problems 14, 15. Section 8.4, problems 5a, 5c.

4. Section 6.3, problems 1a, 1c, 1f, 2a, 2b, 2c (sigma notation)

5. In this problem you will prove that $\int_0^b x^3 \, dx = \frac{b^4}{4}$.

   (a) Approximate this area using $n$ rectangles of equal width. Write one formula (in sigma notation) which overestimates the area and one which underestimates it.

   (b) Use the identity $\sum_{i=0}^n k^3 = \left( \frac{n(n+1)}{2} \right)^2$ to simplify the two formulas. (If you want to see a nice proof of this identity, look at section 6.3, problem 8)

   (c) How do these formulas behave as $n$ approaches $\infty$? Conclude that $\int_0^b x^3 \, dx = \frac{b^4}{4}$. 
6. Sketch two possible antiderivative graphs for each of the following functions: