

**Exam 4**  
Math 131  
November 30, 2007

Name \_\_\_\_\_

No credit is given for the answer. You must show your work (steps) to obtain credit.

1. Find each of the following indefinite integrals. (3 pts each)

(a)  $\int 5 \sec^2(x) dx.$

(b)  $\int (3e^x - x) dx.$

(c)  $\int \frac{3}{\sqrt{1-x^2}} dx.$

(d)  $\int 4 \sec(x) \tan(x) dx.$

(e)  $\int 2x^{-2} + \frac{1}{\sqrt{x}} dx.$

2. Calculate  $\sum_{i=1}^{200} 4 - 3i - i^2$  (8 pts)

3. Find the sum  $\sum_{i=1}^n \frac{1}{n} \left[ 4 \left( \frac{2i}{n} \right)^2 - \left( \frac{2i}{n} \right) \right]$  then find the limit of your sum as  $n \rightarrow \infty$  (8 pts)

4. A three-sided fence is to be built next to a straight section of river, which forms the fourth side of the rectangular region. The enclosed area is to equal  $1800 \text{ ft}^2$ . Find the minimum perimeter and the dimensions of the enclosure with this minimum perimeter. (8 pts)

5. Use the following table of values to estimate the area under the curve  $f(x)$  using right endpoint evaluation. (8 pts)

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6
f(x)	0.0	0.4	0.6	0.8	1.2	1.4	1.2	1.4	1.0

6. Use midpoint sums with  $n = 71$  to estimate the area under the curve  $y = \sqrt{x+2}$  on the interval  $[0, 2]$ . (Use calculator, write down the command you typed into the calculator to show work.) (8 pts)

7. Use left hand sums with  $n = 3$  to estimate the area under  $y = x^2 - 1$  between  $x = 1$  and  $x = 2$ . Write the sum out by hand. You may use the calculator to find values but the sum must be written out then added. (8 pts)

8. Write the definite integral that describes the area above the  $x$ -axis below the curve  $y = 4 - x^2$ . (8 pts)
9. Estimate, using Riemann sums,  $\int_0^2 \sqrt{x^2 + 1} \, dx$  to 2 decimals of accuracy. (8 pts)
10. Suppose a forest fire spreads in a circle with radius changing at a rate of 5 feet per minute. When the radius is 200 feet at what rate is the area of the burning region changing? (7 pts)

11. Sand is dumped such that the shape of the sandpile remains a cone with height equal to twice its radius. If the sand is dumped at a constant rate of  $20 \text{ ft}^3/\text{s}$ , find the rate at which the radius is increasing when the height is 6 feet. (Volume of a cone is given by the formula  $V = \frac{1}{3}\pi r^2 h$  where  $r$  is the radius and  $h$  is the height.) (7 pts)
12. A city wants to build a new section of highway to link an existing bridge with an existing highway interchange, which lies 8 miles to the east and 10 miles to the south of the bridge. The first 4 miles south of the bridge is marshland. Assume that the highway costs \$5 million per mile over marsh and \$2 million per mile over dry land. The highway will be built in a straight line from the bridge to the edge of the marsh, then in a straight line to the existing interchange. At what point should the highway emerge from the marsh in order to minimize the total cost of the new highway? (7 pts)