

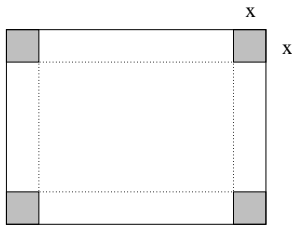
Name: \_\_\_\_\_

Section: \_\_\_\_\_

**Instructions:** Graphing calculators without stored notes or formulas are allowed. Storing notes or formulas is considered academic dishonesty and calculators may be checked during the exam. Remember that unless otherwise stated all definite integrals must be computed by finding the anti-derivative and then evaluating (not by using the SUM program). **You must show work.** This is a 140 point, 6 page exam. **Good Luck.**

- |         |         |          |             |
|---------|---------|----------|-------------|
| 1 _____ | 5 _____ | 9 _____  | 13 _____    |
| 2 _____ | 6 _____ | 10 _____ | 14 _____    |
| 3 _____ | 7 _____ | 11 _____ |             |
| 4 _____ | 8 _____ | 12 _____ | Total _____ |

1. (10 pts) An open top rectangular box is to be made from a  $12 \times 18$  inch piece of cardboard by cutting a square of side  $x$  from each corner and folding up the sides along the dotted edges (See figure below). Find  $x$  if the resulting box has a maximum volume.



2. (10 pts) Let  $F(x) = \int_1^x e^{-t^2} \sqrt{1+t^2} dt$ .

Find (a)  $F(1) =$  \_\_\_\_\_

and  $F'(1) =$  \_\_\_\_\_

.

3. (10 pts) Use L'Hopital's rule to evaluate  $\lim_{x \rightarrow 0} \frac{e^{3x} - 3x - 1}{x^2}$

4. (10 pts) Below is the graph of  $f'(x)$ , the derivative of  $f(x)$ .

(a) On what intervals is  $f(x)$  increasing? Decreasing?

(b) On what intervals is  $f(x)$  concave up? Concave down?

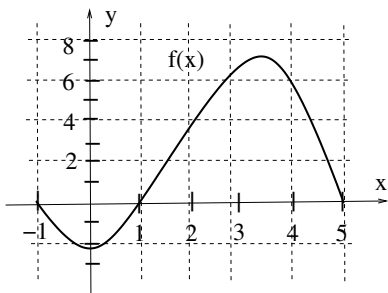
(c) If  $f(0) = 0$ , indicate whether each of the following is positive (+), negative (-), or zero (0).

(i)  $f(1)$  \_\_\_\_\_

(ii)  $f(3)$  \_\_\_\_\_

(iii)  $f(5)$  \_\_\_\_\_

(iv)  $f(-1)$  \_\_\_\_\_



5. (10 pts) Let  $f(x) = \frac{1}{\sqrt{x+8}}$ .

(a) Find  $f'(1)$

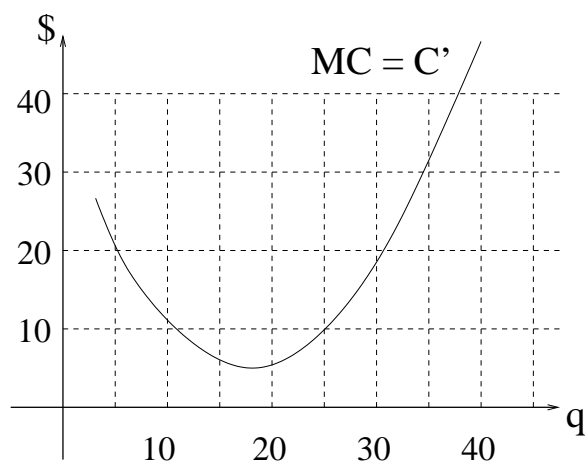
(b) Find the tangent line approximation to  $f(x)$  near  $x = 1$ .

(c) Use (b) to approximate  $f(1.01)$ .

6. (10 pts) Suppose the revenue from selling  $q$  items is given by  $R(q) = 0.25q^2 + 10q - 5$ . The graph of  $MC$ , the marginal cost, is given in the figure below.

(a) Determine the marginal revenue and sketch its graph on the same coordinate system on which the graph of  $MC$  is drawn.

(b) Estimate the quantity  $q$  that maximizes profit.

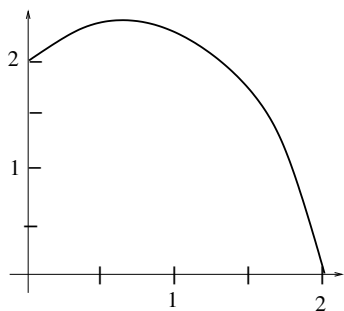


7. (10 pts) A potato is launched with an initial upward velocity of 112 ft/sec from the roof of a dorm 128 ft above the ground. Throughout its flight, the acceleration of the potato is a constant  $-32$  ft/sec<sup>2</sup>.

(a) Find the formulas for **both the velocity** of the potato at time  $t$  sec and **the height** of the potato at time  $t$  sec.

(b) Find the maximum height of the potato.

8. (10 pts) Below is a graph of the function  $f(x) = -x^2 + x + 2$  on the interval  $[0, 2]$ .



(a) Approximate the area between the curve and the  $x$ -axis on the interval  $[0, 2]$  by using a left-hand sum with  $n = 4$  subintervals.

(b) On the graph, draw the rectangles which correspond to the calculation in (a).

(c) Use integration and the Fundamental Theorem to compute the area of the region exactly.

Find each of the following integrals using basic integration, substitution and/or integration by parts or the method indicated.

9. (10 pts)  $\int x^3 \ln x \, dx$

10. (10 pts)  $\int \frac{1}{x(\ln x)^2} \, dx$

11. (10 pts)  $\int_0^\pi x^2 \cos x \, dx$

12. (10 pts)  $\int (x + 1)e^{2x} dx$

13. (10 pts)  $\int \frac{x - 2}{x(x - 1)} dx$  (hint: partial fractions)

14. (10 pts)  $\int \frac{1}{(\sqrt{9 - x^2})^3} dx$  (hint: trigonometric substitution)