

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

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

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This area is for grader's use.

1 \_\_\_\_\_ 5 \_\_\_\_\_ 9 \_\_\_\_\_ 13 \_\_\_\_\_

2 \_\_\_\_\_ 6 \_\_\_\_\_ 10 \_\_\_\_\_ 14 \_\_\_\_\_

3 \_\_\_\_\_ 7 \_\_\_\_\_ 11 \_\_\_\_\_ 15 \_\_\_\_\_

4 \_\_\_\_\_ 8 \_\_\_\_\_ 12 \_\_\_\_\_ 16 \_\_\_\_\_

Total Points: \_\_\_\_\_

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**Instructions:** All answers must include supporting work and an explanation of your reasoning when asked for.

1. (10 pts) Solve the initial value problem:  $\frac{dy}{dx} = e^{3x} + \frac{1}{(x+1)}$ ,  $y(0) = 4/3$

2. (10 pts) Evaluate  $\int \frac{x^2 - x + 1}{x} dx$

3. (10 pts) A potato is thrown vertically upward with an initial velocity of 112 ft/sec from a roof 100 feet above the ground. Assume 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  $t$  seconds and the height of the potato at time  $t$  seconds.
- (b) Find the maximum height of the potato.
- (c) Find the maximum speed attained by the potato.
4. (10 pts) For  $-1 \leq x \leq 1$ , define  $F(x) = \int_{-1}^x \sqrt{1-t^2} dt$ .
- (a) Find  $F'(x)$ .
- (b) What does  $F(1)$  represent geometrically? (Hint: Sketch a graph of  $F'(x)$ )
- (c) What are the values of  $F(-1)$  and  $F(0)$ ?

5. (10 pts) A potato is taken out of the oven and begins to cool. The temperature of the potato changes at a rate of  $-300e^{-2t}$  degrees per hour, where  $t$  is the number of hours since removal. Use the Fundamental Theorem to find the total change in temperature of the potato after  $1/2$  hour? (Show your work, which must involve a definite integral and the Fundamental Theorem.)
6. (10 pts) The graph of the derivative  $f'$  of  $f$  is given below.
- (a) Where is  $f(x)$  decreasing? (b) Where is  $f(x)$  concave up?
- (c) Use the Fundamental Theorem to find the exact value of  $f(2)$  if  $f(0) = 8$ .
7. (10 pts) The printed area of a poster is to cover an area of 2,000 square inches. The top and bottom margins are each to be 6 inches while the side margins are each to be 4 inches. Find the dimensions of the smallest piece of poster board on which the poster can be printed.

8. (10 pts) Use l'Hopital's Rule to evaluate the following limit:

$$\lim_{x \rightarrow 0} \frac{\sin(x) - x}{x^3}$$

9. (10 pts) Let  $f'(x) = e^x(x + 5)$  be the derivative of the function  $f(x)$ .

(a) On which intervals is  $f(x)$  increasing?

(b) Does  $f(x)$  have a global maximum value? If so, find the value of  $x$  where it occurs.

(c) Does  $f(x)$  have a global minimum value? If so, find the value of  $x$  where it occurs.

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

(a) Find the tangent line approximation to  $f(x)$  at  $x = 0$ .

(b) Use the tangent line approximation to estimate  $\sqrt{0.9}$ .

11. (10 pts) Evaluate  $\int \frac{1}{\sqrt{9-4x^2}} dx$  using the substitution  $x = \frac{3}{2} \sin t$ .

12. (10 pts) Use the Fundamental Theorem to find the exact total area bounded between the  $x$ -axis and the curve  $y = x^3 + x^2 - 2x$ .

13. (10 pts) Evaluate  $\int \frac{1}{x(\ln x)^2} dx$

14. (10 pts) Evaluate  $\int (\cos(3x))^2 \sin(3x) dx$

15. (10 pts) Evaluate  $\int (x+1)e^{2x} dx$

16. (10 pts) Evaluate  $\int \frac{2x+6}{x(x+2)} dx$  (Use partial fractions)