Please show **all** your work! Answers without supporting work will not be given credit. Write answers in spaces provided.

Name:__

- 1. Which derivative rule is undone by integration by substitution?
 - (A) Power Rule
 - (B) Quotient Rule
 - (C) Product Rule
 - (D) Chain Rule
 - (E) Constant Rule
 - (F) None of these

- 2. Which derivative rule is undone by integration by parts?
 - (A) Power Rule
 - (B) Quotient Rule
 - (C) Product Rule
 - (D) Chain Rule
 - (E) Constant Rule
 - (F) None of these
- 3. What would be the best substitution to make the solve the given integral?

$$\int e^{2x} \cos(e^{2x}) \sin^3(e^{2x}) \, dx$$

u =

4. What would be the best substitution to make the solve the given integral?

$$\int \sec^2(5x) e^{\tan(5x)} \, dx$$

 $u = _$

5. What would be the best substitution to make the solve the given integral?

$$\int \tan(5x) \sec(5x) e^{\sec(5x)} \, dx$$

6. Find the area under the curve $y = 14e^{7x}$ for $0 \le x \le 4$.

Area = _____

7. Evaluate the definite integral.

$$\int_0^2 (5e^{2x} + 8) \, dx$$

$$\int_{0}^{2} (5e^{2x} + 8) \, dx = _$$

8. Evaluate the indefinite integral.

$$\int 64x^7 \sin(x^8) \, dx$$

$$\int 64x^7 \sin(x^8) \, dx = \underline{\qquad}$$

9. Evaluate the indefinite integral.

$$\int 9x^3 e^{-x^4} \, dx$$

 $\int 9x^3 e^{-x^4} dx = \underline{\qquad}$

10. Evaluate the indefinite integral.

$$\int \frac{28x}{x^2 + 11} \, dx$$

$$\int \frac{28x}{x^2 + 11} \, dx = \underline{\qquad}$$

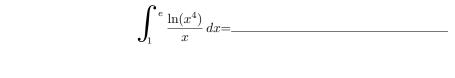
11. Evaluate the indefinite integral

$$\int \frac{\ln(5x)}{x} \, dx$$

$$\int \frac{\ln(5x)}{x} \, dx = \underline{\qquad}$$

12. Evaluate

$$\int_{1}^{e} \frac{\ln(x^4)}{x} \, dx$$



13. After an oil spill, a company uses oil-eating bacteria to help clean up. It is estimated that t hours after being placed in the spill, the bacteria will eat the oil at a rate of

 $L'(t) = \sqrt{3t+2}$ gallows per hour.

How many gallons of oil will the bacteria eat in the first 4 hours? Round to 4 decimal places.

14. It is estimated that t-weeks into a semester, the average amount of sleep a college math student gets per day S(t) changes at a rate of

$$\frac{-4t}{e^{t^2}}$$

hours per day. When the semester begins, math students sleep an average of 8.2 hours per day. What is S(t), 2 weeks into the semester?

15. A biologist determines that, t hours after a bacterial colony was established, the population of bacteria in the colony is changing at a rate given by

$$P'(t) = \frac{5e^t}{1+e^t}$$

million bacteria per hour, $0 \le t \le 5$.

If the bacterial colony started with a population of 1 million, how many bacteria, in millions are present in the colony after the 5-hour experiment?

16. Evaluate

 $\int 3x \ln(x^7) \, dx$

 $\int 3x \ln(x^7) \, dx = \underline{\qquad}$

17. Evaluate the indefinite integral.

 $\int 4x \sin(7x) \, dx$

 $\int 4x \sin(7x) \, dx = \underline{\qquad}$

18. The velocity of a cyclist during an hour-long race is given by the function

$$v(t) = 166te^{-2.2t}$$
 mi/hr, $0 \le t \le 1$

Assuming the cyclist starts from rest, what is the distance in miles he traveled during the first hour of the race?

19. Which of the following is a partial fraction decomposition of the rational expression show? Do not explicitly solve for the constant. 3x + 1

(A)

$$f(x) = \frac{-6x + 1}{x^2(x+1)^2(x^2+1)}$$
(A)

$$\frac{A}{x^2} + \frac{B}{(x+1)^2} + \frac{C}{x^2+1}$$
(B)

$$\frac{A}{x} + \frac{B}{x^2} + \frac{C}{x+1} + \frac{D}{(x+1)^2} + \frac{E}{x^2+1}$$
(C)

$$\frac{A}{x} + \frac{B}{x^2} + \frac{C}{x+1} + \frac{D}{(x+1)^2} + \frac{Ex + F}{x^2+1}$$
(D)

$$\frac{A}{x} + \frac{Bx + C}{x^2} + \frac{D}{x+1} + \frac{Ex + F}{(x+1)^2} + \frac{Gx + H}{x^2+1}$$
(E)

$$\frac{A}{x} + \frac{B}{(x+1)^2} + \frac{C}{x^2+1}$$

20. Determine the partial fraction decomposition of

$$\frac{7x^2+9}{x^3+3x}$$

21. Determine the partial fraction decomposition of

$$\frac{4x - 11}{x^2 - 7x + 10}$$

22. Evaluate
$$\int \frac{5x^2 + 9}{x^3 + 3x^2} dx$$

$$\int \frac{5x^2 + 9}{x^3 + 3x^2} \, dx = \underline{\qquad}$$

23. Evaluate
$$\int \frac{x^2 + 2}{x^3 + 3x^2 + 2x} dx$$

$$\int \frac{x^2 + 2}{x^3 + 3x^2 + 2x} \, dx = \underline{\qquad}$$