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

Name:____

1. Evaluate the indefinite integral.

$$\int 18x\cos(x^2)\,dx$$

$$\int 18x\cos(x^2)\,dx = \underline{\hspace{6cm}}$$

2. Evaluate the indefinite integral.

$$\int 11x^2e^{-4x^3}\,dx$$

$$\int 11x^2e^{-4x^3}\,dx = \underline{\hspace{6cm}}$$

3. A forestry company estimates that acres of forest available for logging will increase at a rate given by $R'(t) = \dfrac{56}{\sqrt{t+7}}$ for $0 \le t \le 20$ where $R'(t)$ is the rate of new acreage becoming available in thousands of acres per year, t years after the current year. How many acres of forest will become available for logging over the first 5 years? Round your answer to the nearest thousand acres.

Answer:______________________________

4. Find the area under the curve $y = 7\cos(4x)$ for $0 \le x \le \pi/2$.

Area = ______________________________

5. Evaluate the indefinite integral

$$\int \frac{\ln(7x)}{x}\,dx$$

$$\int \frac{\ln(7x)}{x}\,dx = \underline{\hspace{6cm}}$$

6. Evaluate the definite integral.

$$\int_1^e \frac{\ln(x)}{x}\,dx$$

$$\int_1^e \frac{\ln(x)}{x}\,dx = \underline{\hspace{6cm}}$$

7. Evaluate the indefinite integral.

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

$$\int x^3 \ln(9x)\, dx = \underline{\hspace{6cm}}$$

8. Evaluate

$$\int 3x \ln(x^6)\, dx$$

$$\int 3x \ln(x^6)\, dx = \underline{\hspace{6cm}}$$

9. Evaluate the indefinite integral.

$$\int 20x \sin(2x)\, dx$$

$$\int 20x \sin(2x)\, dx = \underline{\qquad\qquad\qquad\qquad}$$

10. Evaluate the indefinite integral.

$$\int 18x \cos(3x)\, dx$$

$$\int 18x \cos(3x)\, dx = \underline{\qquad\qquad\qquad\qquad}$$

11. Which of the following is a partial fraction decomposition of the rational expression show? Do not explicitly solve for the constant.

$$f(x) = \frac{7x - 5}{x^2(x^2 + 9)}$$

(A) $\frac{A}{x} + \frac{B}{x} + \frac{Cx + D}{x^2 + 9}$

(B) $\frac{A}{x} + \frac{B}{x^2} + \frac{Cx + D}{x^2 + 9}$

(C) $\frac{A}{x} + \frac{Bx + C}{x^2} + \frac{Dx + E}{x^2 + 9}$

(D) $\frac{Ax + B}{x^2} + \frac{Cx + D}{x^2 + 9}$

(E) $\frac{A}{x} + \frac{B}{x^2} + \frac{C}{x + 3} + \frac{D}{x - 3}$

(F) $\frac{Ax + B}{x^2} + \frac{C}{x + 3} + \frac{D}{x - 3}$

12. Which of the following is a partial fraction decomposition of the rational expression show? Do not explicitly solve for the constant.

$$f(x) = \frac{2x}{(x - 1)^2(x^2 + 5)}$$

(A) $\frac{A}{x - 1} + \frac{Bx + C}{(x - 1)^2} + \frac{D}{x^2 + 5}$

(B) $\frac{A}{(x - 1)^2} + \frac{Bx + C}{x^2 + 5}$

(C) $\frac{A}{x - 1} + \frac{B}{(x - 1)^2} + \frac{Cx + D}{x^2 + 5}$

(D) $\frac{A}{x - 1} + \frac{Bx + C}{(x - 1)^2} + \frac{Dx + E}{x^2 + 5}$

(E) $\frac{A}{x - 1} + \frac{Bx + C}{x^2 + 5}$

(F) $\frac{Ax + B}{(x - 1)^2} + \frac{Cx + D}{x^2 + 5}$

13. Evaluate the improper integral or state that it is divergent.

$$\int_3^\infty \frac{4}{x^5}\,dx$$

$$\int_3^\infty \frac{4}{x^5}\,dx = \rule{5cm}{0.4pt}$$

14. Evaluate the following integral;

$$\int_0^\infty e^{-x/6}dx$$

$$\int_0^\infty e^{-x/6}dx \quad = \quad \rule{5cm}{0.4pt}$$

15. Evaluate the definite integral.

$$\int_2^\infty \frac{dx}{3x+1}$$

$$\int_2^\infty \frac{dx}{3x+1} = \underline{\hspace{6cm}}$$

16. Set up the integral that represents the **AREA** of the region bounded by the following curves:

$$y = \frac{1}{2}x^2, \qquad y = -x^2 + 6$$

Area $=$ ______________________________

17. Find the **AREA** of the region bounded by $y = 2x - x^2$ and $y = x^2$.

Area $=$ ________________________

18. Find the **VOLUME** of the solid that results by revolving the region enclosed by the following curves about the x-axis.

$$y = 3x, x = 1, x = 4, \text{ and } y = 0$$

Volume $=$ ________________________

19. Find the **VOLUME** of the solid generated by rotating the region bounded by

$$y = x + 2, \quad x = 0, \quad y = 6$$

around the y-axis

Volume $=$ ____________________

20. **SET-UP using the washer method.** the **VOLUME** of the region bounded by

$$y = x^2, \quad y = 2x$$

around the x-axis

(A) $\pi \int_0^2 (2x - x^2)^2 \, dx$

(B) $\pi \int_0^2 (4x^2 - x^4) \, dx$

(C) $\pi \int_0^2 (2x - x^2) \, dx$

(D) $\pi \int_0^2 (x^2 - 2x) \, dx$

(E) $\pi \int_0^2 (x^4 - 4x^2) \, dx$

(F) $2\pi \int_0^2 (x^3 - 2x^2) \, dx$

21. Set-up the definite integral that would calculate the **VOLUME** of the region bounded by the following curves when rotated about the x-axis.

$$y = 5x \text{ and } y = 15\sqrt{x}$$

VOLUME = ____________________________

22. Find the **VOLUME** of the solid obtained by revolving the region bounded by the following curves about the y-axis.

$$x + 2y = 4, x = 0, \text{ and } y = 0$$

VOLUME = ____________________________

23. Find the general solution of the given differential equation.

$$\frac{dy}{dx} = \frac{4x}{y}$$

$y=$ ______________________________

24. Find the particular solution to the given differential equation if $y(2) = 3$

$$\frac{dy}{dx} = \frac{x}{y^2}$$

$y=$ ______________________________

25. Find the particular solution of the equation.

$$\frac{dy}{dx} - 5y = 0, y(1) = 7$$

$y=$ ______________________________

26. The rate of change of the population $N(t)$ of a sample of bacteria is directly proportional to the number of bacteria, so $N'(t) = kN$, where time t is measured in minutes. Initially, there are 270 bacteria present. If the number of bacteria after 7 minutes is 770, find the growth rate k in terms of minutes. Round to four decimal places.

$k=$ ______________________________

27. What is the **integrating factor** of the following differential equation?

$$y' + \left(\frac{2x+3}{x}\right) y = 10\ln(x)$$

$u(x) =$ ______________________

28. Find the general solution of the following differential equation.

$$\frac{dy}{dx} + \frac{4y}{x} = 2x + 20$$

$y =$ ______________________

29. Compute the following sum.

$$\sum_{n=0}^{\infty}\left(\frac{(-1)^n}{3^n}+\frac{2^{n+1}}{3^n}\right)$$

Answer:____________________

30. Evaluate the sum of the following infinite series.

$$\sum_{n=1}^{\infty}\frac{4(3)^{n-1}}{5^n}$$

Answer:____________________

31. Find the sum of the following series:

$$\sum_{n=0}^{\infty} \frac{(-2)^n}{3^{2n+1}}$$

Answer:________________________________

32. Express $f(x) = \dfrac{x}{3+x}$ as a power series.

$$\frac{x}{3+x} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

33. Express $f(x) = \dfrac{x}{4+3x^2}$ as a power series.

$$\frac{x}{4+3x^2} = \underline{\hspace{6cm}}$$

34. What are the first 3 non-zero terms of the Maclaurin series representation of the follow?

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

$$\int e^{-3x}\,dx = \underline{\hspace{6cm}}$$

35. Find the Maclaurin representation of the following:

$$\int \cos(\sqrt{x})\,dx$$

$$\int \cos(\sqrt{x})\,dx = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

36. Given $f(x, y) = 3x^3y^2 - x^2y^{1/3}$, evaluate $f(3, -8)$.

$f(3, -8)=$ ____________________

37. What do the level curves for the following function look like?

$$f(x,y) = 12\ln(6(x-3)^2 + 6(y-2)^2)$$

(a) Lines
(b) Parabolas
(c) Circles
(d) Point at the origin
(e) Ellipses
(f) Hyperbolas

38. What do the level curves for the following function look like?

$$f(x,y) = \sqrt{y + 4x^2}$$

(a) Lines
(b) Parabolas
(c) Circles
(d) Point at the origin
(e) Ellipses
(f) Hyperbolas

39. What do the level curves for the following function look like?

$$f(x,y) = \ln(y - e^{5x})$$

(a) Increasing exponential functions
(b) Rational Functions with x-axis symmetry
(c) Natural logarithm functions
(d) Decreasing exponential functions
(e) Rational Functions with y-axis symmetry

40. What do the level curves for the following function look like?

$$f(x,y) = \cos(y + 4x^2)$$

(a) Lines
(b) Parabolas
(c) Circles
(d) Point at the origin
(e) Ellipses
(f) Hyperbolas

41. Given $f(x, y) = x\sin(xy^2)$, evaluate $f_y(3, 7)$. Round to 4 decimal places.

$f_y(3, 7) =$ ____________________

42. Find the first order partial derivatives of $f(x, y) = xe^{xy}$

$f_x(x, y) =$ ____________________

$f_y(x, y) =$ ____________________

43. For the given function $f(x,y)$, find $f_x(x,y)$.

$$f(x,y) = 5\cos(x^7 y^8)$$

$f_x(x,y) =$ ______________________

44. Given the function $f(x,y) = x^3y^2 - 3x + 5y - 5x^2y^3$, compute $f_{xx}(x,y)$

$f_{xx}(x,y) =$ ______________________

45. Given the function $f(x, y) = x^3 \sin(y)$, compute $f_{xy}(2, 0)$

$f_{xy}(2, 0) =$ ____________________

46. For the function $f(x, y)$, find $f_{xy}(\pi, 2)$.

$$f(x, y) = 8y^5 \sin(x)$$

$f_{xy}(\pi, 2) =$ ____________________

47. At what point (x, y) does the function $f(x, y)$ have a local minimum?

$$f(x, y) = 7x^2 - xy + 5y^2 + 75x + 84y + 2$$

Local min occurs at ____________________

48. Given the information below, which critical point(s) (a, b) would be classified as a relative maximum?

(a, b)	$f_{xx}(a, b)$	$f_{yy}(a, b)$	$f_{xy}(a, b)$
$(7, 8)$	-5	-5	10
$(-8, -1)$	-4	-7	-2
$(1, 7)$	-10	-1	6

Answer: ____________________

49. Given the table below,

(a, b)	$f_{xx}(a, b)$	$f_{yy}(a, b)$	$f_{xy}(a, b)$
$(9, 4)$	-1	-1	-1
$(-2, 2)$	4	3	-4
$(4, 5)$	8	5	6

Which statements are true?

I. $f(x, y)$ has exactly 1 saddle points

II. $f(x, y)$ has exactly 1 relative minimum

III. $f(x, y)$ has exactly 1 relative maximum

IV. $f(x, y)$ has exactly 1 inconclusive critical point

Answer:______________________________

50. The critical points for a function $f(x, y)$ are (0,0) and (8,4). Given that the partial derivatives of $f(x, y)$ are

$$f_x(x, y) = 3x - 6y \qquad f_y(x, y) = 3y^2 - 6x$$

Classify each critical point as a maximum, minimum, or saddle point.

(0,0) is ______________________________

(8,4) is ______________________________

51. Classify the critical points of the function $f(x, y)$ given the partial derivatives

$$f_x(x, y) = x - 2y \qquad f_y(x, y) = y^2 - 2x$$

A) 2 Local Minima
B) 2 Saddle Points
C) 1 Saddle Point and 1 Local Minimum
D) 1 Saddle Point and 1 Local Maximum
E) 1 Local Maximum and 1 Local Minimum
F) 2 Local Maxima

52. Find the minimum of the function using LaGrange Multipliers of the function $f(x, y) = x^2 + 2y^2$ subject to the constraint $x^2 + y^2 = 1$.

Minimum Value = ______________________

53. Find the maximum value of the function $f(x, y) = 18x - 19y^2$ subject to the constraint $x^2 + 19y^2 = 81$.

Maximum Value = ______________________

54. A factory can produce a chocolate bar with a weight of $W(x, y) = \dfrac{xy}{100}$ with the weight W in ounces and x and y are the percentages of cocoa and sugar respectively. The percentage of cocoa and sugar are constrained to $2x + y = 75$. What is the weight, in ounces, of the largest chocolate bar that can be produced? Round to 2 decimal places.

Weight of Largest Chocolate Bar = __________

55. Evaluate the double integral

$$\int_0^{\pi/2} \int_0^1 16y^3 \cos(x)\, dy\, dx$$

$$\int_0^1 \int_0^{\pi/2} 16y^3 \cos(x)\, dy\, dx = \underline{\hspace{3cm}}$$

56. Evaluate the double integral

$$\int_0^7 \int_0^{\pi/2} 20y^4 \cos(x)\, dx\, dy$$

$$\int_0^7 \int_0^{\pi/2} 20y^4 \cos(x)\, dx\, dy = \underline{\hspace{3cm}}$$

57. Evaluate the definite integral.

$$\int_0^4 \int_3^x \frac{6x}{y^2}\, dy\, dx$$

$$\int_0^4 \int_3^x \frac{6x}{y^2}\, dy\, dx = \underline{\hspace{6cm}}$$

58. Evaluate the definite integral.

$$\int_0^6 \int_2^x 30x\, dy\, dx$$

$$\int_0^6 \int_2^x 30x\, dy\, dx = \underline{\hspace{6cm}}$$

59. Find the bounds for the integral $\iint\limits_R f(x,y)\,dA$ where R is a triangle with vertices (0,0), (1,0), and (1,2).

Answer:____

60. Switch the order of integration for the following integral

$$\int_0^1 \int_{9y}^{9} f(x,y)\,dx\,dy$$

Answer:____

61. Switch the order of integration on the follow integral

$$\int_0^1 \int_{10y}^{10} f(x,y)\, dx\, dy$$

Answer:____

62. Evaluate the double integral

$$\int_0^1 \int_y^1 2e^{x^2}\, dx\, dy$$

(Hint: Change the order of integration)

$$\int_0^1 \int_y^1 2e^{x^2}\, dx\, dy = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

63. Evaluate the double integral

$$\int_0^2 \int_x^2 4e^{y^2}\, dy\, dx$$

(Hint: Change the order of integration)

$$\int_0^2 \int_x^2 4e^{y^2}\, dy\, dx = \underline{\hspace{6cm}}$$

64. Evaluate the double integral

$$\int_0^1 \int_{\sqrt{y}}^1 sin(x^3)\, dx\, dy$$

(Hint: Change the order of integration)

$$\int_0^1 \int_{\sqrt{y}}^1 sin(x^3)\, dx\, dy = \underline{\hspace{5cm}}$$