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

Name:______________________________________

1. Given $f(x) = 2x^{5/2} - \cos(3\pi x)$, evaluate $f'(4)$.

$f'(4) =$ ____________________________

2. Evaluate the definite integral

$$\int_0^{\pi/6} (3\cos(x) - 6)\, dx$$

$\displaystyle\int_0^{\pi/6} (3\cos(x) - 6)\, dx =$ ______________________

3. A faucet is turned on at 9:00 am and water starts to flow into a tank at the rate of

$$r(t) = 6\sqrt{t}$$

where t is time in hours after 9:00 am and the rate $r(t)$ is in cubic feet per hour.

(a) How much water, in cubic feet, flows into the tank from 10:00 am to 1:00 pm?

Answer:____________________

(b) How many hours after 9:00 am will there be 121 cubic feet of water in the tank?

Answer:____________________

4. 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

5. 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

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

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

$u =$ ____________________

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

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

$u =$ ____________________

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

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

$u =$ ____________________

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

Area = ____________________

10. Evaluate the definite integral.

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

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

11. Evaluate the indefinite integral.

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

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

12. Evaluate the indefinite integral.

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

$$\int 9x^3 e^{-x^4}\,dx = \underline{\hspace{6cm}}$$

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

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

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

Answer:______________________________

14. It is estimated that t-days 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 days into the semester?

Answer:____________________________________

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?

Answer:________________________________

16. Evaluate the indefinite integral

$$\int x(x^2+4)^3\,dx$$

$$\int x(x^2+4)^3\,dx = \underline{\hspace{6cm}}$$

17. Evaluate the definite integral.

$$\int_0^{\pi/4} 3\sin(2x)\,dx$$

$$\int_0^{\pi/4} 3\sin(2x)\,dx = \underline{\hspace{6cm}}$$

18. Evaluate the indefinite integral.

$$\int (x+4)\sqrt{x^2+8x}\,dx$$

$\int (x+4)\sqrt{x^2+8x}\,dx =$ ____________________

19. Evaluate the definite integral.

$$\int_0^9 \frac{dx}{2\sqrt{x}(\sqrt{x}+1)}$$

$\int_0^9 \frac{dx}{2\sqrt{x}(\sqrt{x}+1)}$ ____________________

20. A tree is transplanted and after t years is growing at a rate

$$r'(t) = 1 + \frac{1}{(t+1)^2} \qquad \text{meters per year.}$$

After 2 years it has reached a height of 5 meters. How tall was the tree when it was originally transplanted? Round to one decimal place.

Height = ____________________

21. The marginal revenue from the sale of x units of a particular product is estimated to be $R'(x) = 50 + 350xe^{-x^2}$ dollars per unit, and where $R(x)$ is revenue in dollars. What revenue should be expected from the sale of 100 units? Assume that $R(0) = 0$.

$R(100) =$ ____________________

22. Evaluate the indefinite integral

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

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

23. Evaluate

$$\int_1^e \frac{\ln(x^4)}{x}\,dx$$

$$\int_1^e \frac{\ln(x^4)}{x}\,dx = \underline{\qquad\qquad\qquad\qquad}$$

24. Evaluate the definite integral.

$$\int_0^{\pi/2} (x-1)\sin(x)\,dx$$

$$\int_0^{\pi/2} (x-1)\sin(x)\,dx = \underline{\hspace{6cm}}$$

25. Evaluate

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

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

26. Evaluate

$$\int x^3 \ln(2x)\, dx$$

$$\int x^3 \ln(2x)\, dx = \underline{\hspace{6cm}}$$

27. Evaluate the definite integral.

$$\int_0^3 5xe^{3x}\, dx$$

$$\int_0^3 5xe^{3x}\, dx = \underline{\hspace{6cm}}$$

28. The population of pink elephants in Dumbo's dreams, in hundreds, t years after the year 1980 is given by

$$P(t) = \frac{e^{5t}}{1 + e^{5t}}$$

What is the average population during the decade between 1980 and 2000?

Answer:____________________________

29. Evaluate the indefinite integral.

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

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

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

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

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

Answer:____________________________

31. After t days, the growth of a plant is measured by the function $2000te^{-20t}$ inches per day. What is the change in the height of the plant (in inches) after the first 14 days?

Answer:______________________________

32. Evaluate the indefinite integral.

$$\int 4t\sqrt{2t+5}\,dt$$

$\int 4t\sqrt{2t+5}\,dt =$ ________________________

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

$$f(x) = \frac{3x+1}{x^2(x+1)^2(x^2+1)}$$

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

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

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

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

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

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

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

$$f(x) = \frac{x^2+2x+3}{(x-1)^2(x-2)(x^2+4)}$$

(A) $\frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x-2} + \frac{Dx+E}{x^2+4}$

(B) $\frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x-2} + \frac{D}{x^2+4}$

(C) $\frac{A}{x-1} + \frac{Bx+C}{(x-1)^2} + \frac{D}{x-2} + \frac{E}{x^2+4}$

(D) $\frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x-2} + \frac{Dx}{x^2+4}$

(E) $\frac{A}{x-1} + \frac{Bx}{(x-1)^2} + \frac{C}{x-2} + \frac{Dx+E}{x^2+4}$

36. Determine the partial fraction decomposition of

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

Answer:______________________________

37. Determine the partial fraction decomposition of

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

Answer:__________________________________

38. Evaluate $\int \frac{5x^2+9}{x^2(x+3)}\,dx$

$\int \frac{5x^2+9}{x^2(x+3)}\,dx=$ ____________________

39. Evaluate $\displaystyle\int \frac{x^2+2}{x^3+3x^2+2x}\,dx$

$$\int \frac{x^2+2}{x^3+3x^2+2x}\,dx = \underline{\hspace{6cm}}$$

40. Evaluate $\displaystyle\int \frac{9x^2 - 4x + 5}{(x-1)(x^2+1)}\, dx$

$$\int \frac{x^2+2}{x^3+3x^2+2x}\, dx = \underline{\hspace{6cm}}$$

41. Determine if the following integral is proper or improper.

$$\int_0^{\pi/2} \frac{\sin x}{1-\cos x}\,dx$$

(A) It is improper because of a discontinuity at $x = \pi/6$
(B) It is improper because of a discontinuity at $x = \pi/4$
(C) It is improper because of a discontinuity at $x = \pi/3$
(D) It is improper because of a discontinuity at $x = 0$
(E) It is improper because of a discontinuity at $x = \pi/2$
(F) It is proper since it is defined on the interval $[0, \pi/2]$.

42. Determine if the following integral is proper or improper.

$$\int_0^{\pi/2} \tan(x)\,dx$$

(A) It is improper because of a discontinuity at $x = \pi/6$
(B) It is improper because of a discontinuity at $x = \pi/4$
(C) It is improper because of a discontinuity at $x = \pi/3$
(D) It is improper because of a discontinuity at $x = 0$
(E) It is improper because of a discontinuity at $x = \pi/2$
(F) It is proper since it is defined on the interval $[0, \pi/2]$.

43. Determine if the following integral is proper or improper.

$$\int_0^{\pi/2} \cos(x)\,dx$$

(A) It is improper because of a discontinuity at $x = \pi/6$
(B) It is improper because of a discontinuity at $x = \pi/4$
(C) It is improper because of a discontinuity at $x = \pi/3$
(D) It is improper because of a discontinuity at $x = 0$
(E) It is improper because of a discontinuity at $x = \pi/2$
(F) It is proper since it is defined on the interval $[0, \pi/2]$.

44. Evaluate the following integral;

$$\int_1^{\infty} \frac{5}{\sqrt{x}} dx$$

$$\int_1^{\infty} \frac{5}{\sqrt{x}} dx \quad = \quad \rule{5cm}{0.4pt}$$

45. Evaluate the following integral;

$$\int_1^{\infty} \frac{3}{x^2} dx$$

$$\int_1^{\infty} \frac{3}{x^2} dx \quad = \quad \rule{5cm}{0.4pt}$$

46. Evaluate the following integral;

$$\int_1^{\infty} \frac{10}{x} dx$$

$$\int_1^{\infty} \frac{10}{x} dx \quad = \quad \rule{5cm}{0.4pt}$$

47. Evaluate the following integral;

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

$$\int_0^\infty e^{-x/6} dx \quad = \quad \rule{4cm}{0.4pt}$$

48. Evaluate the following integral;

$$\int_0^\infty \frac{7}{e^{10x}} dx$$

$$\int_0^\infty \frac{7}{e^{10x}} dx \quad = \quad \rule{4cm}{0.4pt}$$

49. Evaluate the definite integral

$$\int_2^\infty \frac{dx}{5x+2}$$

$$\int_2^\infty \frac{dx}{5x+2} = \rule{4cm}{0.4pt}$$

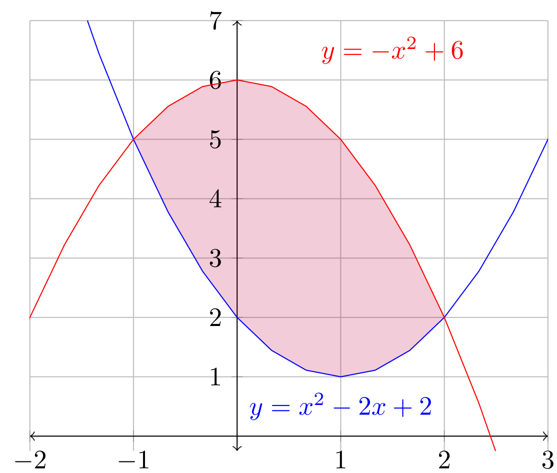
50. The rate at which a factory is dumping pollution into a river at any time t is given by $P(t) = P_0 e^{-kt}$, where P_0 is the rate at which the pollution is initially released into the river. If $P_0 = 3000$ and $k = 0.080$, find the total amount of pollution that will be released into the river into the indefinite future.

Answer:____

51. Set up the integral that computes the **AREA** shown to the right with respect to x.

DON'T COMPUTE IT!!!

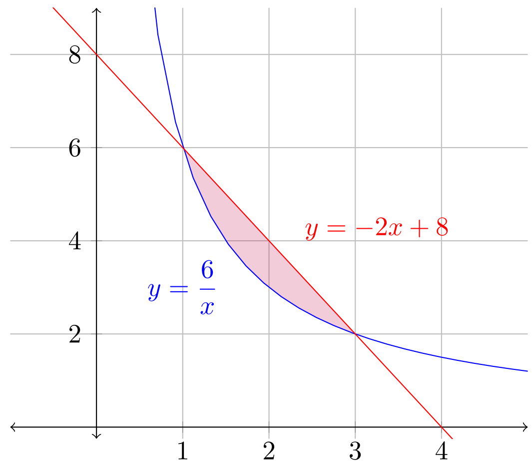
Area $=$ ____________________________



52. Set up the integral that computes the **AREA** shown to the right with respect to y.

DON'T COMPUTE IT!!!

Area $=$ ____________________________



53. Set up the integral that computes the **AREA** with respect to x of the region bounded by

$$y = \frac{2}{x} \quad \text{and} \quad y = -x + 3$$

Area $=$ ____________________

54. Find the area of the region bounded by $y = 6x - x^2$ and $y = 2x^2$.

Area $=$ ____________________

55. Find the area of the region bounded by $y = 2x - x^2$ and $y = x^2$.

Area $=$ ________________________

56. Calculate the **AREA** of the region bounded by the following curves.

$$x = 100 - y^2 \quad \text{and} \quad x = 2y^2 - 8$$

Area $=$ ________________________

57. Calculate the **AREA** of the region bounded by the following curves.

$$y = x^3 \quad \text{and} \quad y = x^2$$

Area $=$ ______________________________

58. After t hours studying, one student is working $Q_1(t) = 25 + 9t - t^2$ problems per hour, and a second student is working on $Q_2(t) = 5 - t + t^2$ problems per hour. How many more problems will the first student have done than the second student after 10 hours?

Answer:______________________________

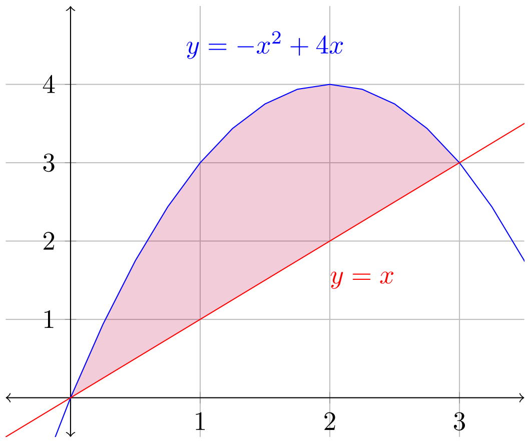
59. The birthrate of a particular population is modeled by $B(t) = 1000e^{0.036t}$ people per year, and the death rate is modeled by $D(t) = 725e^{0.019t}$ people per year. How much will the population increase in the span of 10 years? $(0 \leq t \leq 20)$ Round to the nearest whole number.

Answer:______________________________

60. Let R be the region shown below. Set up the integral that computes the **VOLUME** as R is rotated around the x-axis.

DON'T COMPUTE IT!!!

Volume $=$ ______________________



61. Set up the integral that computes the **VOLUME** of the region bounded by

$$y = \sqrt{16 - x}, \quad y = 0 \quad \text{and} \quad x = 0$$

about the y-axis

Volume $=$ ______________________

62. Set up the integral that computes the **VOLUME** of the region bounded by

$$y = e^{-x}, \quad y = 4 \quad x = 0 \quad \text{and} \quad x = 10$$

about the x-axis

Volume $=$ ____________________

63. Find the volume of the solid that results by revolving the region enclosed by the curves $y = \frac{5}{x}$, $y = 0$, $x = 5$, and $x = 7$ about the x-axis.

Volume $=$ ____________________

64. Find the **VOLUME** of the region bounded by

$$y = 7x, \quad y = 21 \quad x = 1 \quad \text{and} \quad x = 3$$

around the x-axis

Volume $=$ ______________________

65. Find the **VOLUME** of the region bounded by

$$y = 7x, \quad y = 0 \quad x = 1 \quad \text{and} \quad x = 3$$

around the x-axis

Volume $=$ ______________________

66. Set up the integral that computes the **VOLUME** of the region bounded by

$$y = x^2, \quad \text{and} \quad y = \sqrt{x}$$

about the y-axis

Volume $=$ ____________________

67. Set up the integral that computes the **VOLUME** of the region bounded by

$$y = x^2, \quad \text{and} \quad y^2 = x$$

about the x-axis

Volume $=$ ____________________

68. Find the **VOLUME** of the region bounded by

$$y = x - x^2, \quad \text{and} \quad y = 0$$

around the x-axis

Volume $=$ ____________________

69. Find the **VOLUME** of the solid generate by revolving the given region about the x-axis:

$$y = 8\sqrt{x}, \quad y = 0, \quad x = 3, \quad x = 6$$

Volume $=$ ____________________

70. Find the **VOLUME** of the region bounded by

$$y = 4x^2, \quad x = 0, \quad y = 4$$

around the y-axis.

Volume $=$ ______________________

71. Set up the integral that computes the **VOLUME** of the region bounded by

$$y = x + 8, \quad \text{and} \quad y = (x - 4)^2$$

about the x-axis

Volume $=$ ______________________

72. Find the **VOLUME** of the region bounded by

$$y = 10x, \quad x = 0, \quad y = 10$$

around the y-axis

Volume $=$ ____________________

73. 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 $=$ ____________________

74. Find the **VOLUME** of the region bounded by

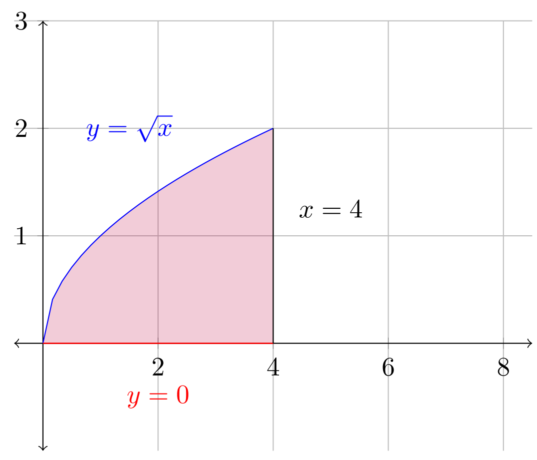
$$x + 3y = 9, \quad x = 0, \quad y = 0$$

around the y-axis

Volume $=$ ______________________________

75. Let R be the region shown to the right. Set up the integral that computes the **VOLUME** as R is rotated around the line $x = 4$.

DON'T COMPUTE IT!!!



Volume $=$ ________________________

76. **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) $2\pi \int_0^2 (x^3 - 2x^2) \, dx$

77. Set up the integral needed to find the volume of the solid obtained when the region bounded by

$$y = 2 - x^2 \quad \text{and} \quad y = x^2$$

is rotated about the line $y = 3$.

Volume = ______________________

78. **SET-UP using the disk/washer method.** the **VOLUME** of the region bounded by

$$y = 3x, \quad x = 0, \quad y = 27$$

around the line $y = 27$

(A) $\pi \int_0^{27} (729 - 162x + 9x^2)\, dx$

(B) $\pi \int_0^{27} 9x^2\, dx$

(C) $\pi \int_0^{9} 9x^2\, dx$

(D) $\pi \int_0^{9} (9x^2 - 162x)\, dx$

(E) $\pi \int_0^{27} (729 - 9x^2)\, dx$

(F) $\pi \int_0^{9} (729 - 162x + 9x^2)\, dx$

79. **SET-UP using the Shell method**, the integral that computes the **VOLUME** of the region in quadrant I enclosed by the region defined by a triangle with vertices at (0,0), (0,5), and (4,0) about the y-axis.

(A) $\pi \int_0^{5} \left(8x - \frac{5}{4}x^2\right)\, dx$

(B) $\pi \int_0^{5} \frac{5}{4}x^2\, dx$

(C) $\pi \int_0^{4} 4x^2\, dx$

(D) $\pi \int_0^{4} \left(8x - \frac{5}{4}x^2\right)\, dx$

(E) $\pi \int_0^{4} \left(10x - \frac{5}{2}x^2\right)\, dx$

(F) $\pi \int_0^{5} \left(10x - \frac{5}{2}x^2\right)\, dx$

80. Find the **VOLUME** of the region bounded by

$$y = 3x^2, \quad x = 0, \quad y = 27$$

around the line $y = 27$

Volume $=$ ____________________

81. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$x = 2y - y^2, \quad \text{and} \quad x = 0$$

about the x-axis.

Volume $=$ ____________________

82. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$y = 2 - x^2, \quad \text{and} \quad y = x^2$$

about the y-axis.

Volume = ______________________

83. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$y = 3\sqrt{x}, \quad \text{and} \quad y = x$$

about the $x = 12$.

Volume = ______________________

84. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$y = x, \quad \text{and } y = x^2$$

about the line $x = -2$.

Volume $=$ ____________________________

85. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$y = 7x^2, \quad y = 0 \text{ and } \quad x = 2$$

about the line $x = 3$.

Volume $=$ ____________________________

86. Using the **Shell Method**, set up the integral that computes the **VOLUME** of the region bounded by

$$x = y^2 + 1, \text{ and } \quad x = 2$$

about the line $y = -2$.

Volume $=$ ____________________

87. The rate of change of the population $n(t)$ of a sample of bacteria is directly proportional to the number of bacteria present, so $N'(t) = kN$, where time t is measured in minutes. Initially, there are 210 bacteria present. If the number of bacteria after 5 hours is 360, find the growth rate k in terms of minutes. Round to four decimal places.

$k=$ ____________________

88. Let y denote the mass of a radioactive substance at time t. Suppose this substance obeys the equation

$$y' = -18y$$

Assume that initially, the mass of the substance is $y(0) = 20$ grams. At what time t in hours does half the original mass remain? Round your answer to 3 decimal places.

t = ______________________

89. Find the general solution to the differential equation:

$$\frac{dy}{dx} = \frac{3x^2}{y}$$

y = ______________________

90. Find the general solution to the differential equation:

$$\frac{dy}{dx} = 5y$$

$y \quad = \quad$ ______________________________

91. Find the general solution to the differential equation:

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

$y \quad = \quad$ ______________________________

92. Find the general solution to the given differential question. Use C as an arbitrary constant.

$$\frac{dy}{dt} - 15y = 0$$

$y =$ ______________________________

93. Find the general solution to the given differential question. Use C as an arbitrary constant.

$$\frac{dy}{dx} = \frac{3}{y}$$

$y =$ ______________________________

94. Find the general solution to the given differential question. Use C as an arbitrary constant.

$$\frac{dy}{dx} = 3x^2y$$

$y =$ ______________________________

95. Find the general solution to the given differential question. Use C as an arbitrary constant.

$$\frac{dy}{dt} = 8e^{-4t-y}$$

$y =$ ______________________________

96. Find the particular solution to the differential equation.

$$\frac{dy}{dx} = \frac{3x+2}{2y} \text{ and } y(0) = 4$$

$y =$ ____________________________

97. Find the particular solution to the differential equation.

$$\frac{dy}{dx} = \frac{5y}{6x+3} \text{ and } y(0) = 1$$

$y =$ ____________________________

98. Consider the following IVP:

$$\frac{dy}{dx} = 11x^2e^{-x^3} \quad \text{where} \quad y = 10 \quad \text{when} \quad x = 2$$

Find the value of the integration constant, C.

$C =$ ______________________

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

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

$y=$ ______________________

100. Calculate the constant of integration, C, for the given differential equation.

$$\frac{dy}{dx} = \frac{7x^3}{6y}, \qquad y(1) = 2$$

$C=$ ________________________________

101. The volume of an object $V(t)$ in cubic millimeter at any time t in seconds changes according to the model

$$\frac{dV}{dt} = \cos\left(\frac{t}{10}\right),$$

where $V(0) = 5$. Find the volume of the object at $t = 3$ seconds. Round to 4 decimal places.

$V(3) =$ ________________________________

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

$$2y' + \left(\frac{6}{x}\right) y = 10\ln(x)$$

$u(x) =$ ______________________

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

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

$u(x) =$ ______________________

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

$$x^8 y' - 14x^7 y = 32e^{7x}$$

$u(x) =$ ______________________________

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

$$(x+1)\frac{dy}{dx} - 2(x^2+x)y = (x+1)e^{x^2}$$

$u(x) =$ ______________________________

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

$$y' + \cot(x) \cdot y = \sin^2(x)$$

$u(x) =$ ____________________

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

$$y' + \tan(x) \cdot y = \sec(x)$$

$u(x) =$ ____________________

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

$$\frac{dy}{dx} + (4x - 1)y = 8x - 2$$

$y =$ ______________________

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

$$\frac{dy}{dx} + \frac{6y}{x} = x + 10$$

$y =$ ______________________

110. Find the particular solution to the differential equation.

$$\frac{dy}{dx} = 6x^2(y+4) \text{ and } y(0) = 3$$

$y =$ ______________________________

111. Solve the initial value problem.

$$x^4 y' + 4x^3 \cdot y = 10x^9 \text{ with } f(1) = 23$$

$y =$ ______________________________

112. (a) Use summation notation to write the series in compact form.

$$1 - 0.6 + 0.36 - 0.216 + \ldots$$

Answer:________________________________

(b) Use the sum from (a) and compute the sum.

Answer:________________________________

113. If the given series converges, then find its sum. If not, state that it diverges.

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

$$\sum_{n=0}^{\infty} \left(\frac{3}{2}\right)^n = \underline{\hspace{6cm}}$$

114. If the given series converges, then find its sum. If not, state that it diverges.

$$\sum_{n=0}^{\infty} 6\left(-\frac{1}{9}\right)^n$$

$\sum_{n=0}^{\infty} 6\left(-\frac{1}{9}\right)^n =$ ____________________

115. If the given series converges, then find its sum. If not, state that it diverges.

$$\sum_{n=0}^{\infty} \left(\frac{7}{4^n}\right)$$

$\sum_{n=0}^{\infty} \left(\frac{7}{4^n}\right) =$ ____________________

116. Compute

$$\sum_{n=1}^{\infty} \frac{5^{n+2}}{6^n}$$

$\sum_{n=1}^{\infty} \frac{5^{n+2}}{6^n} =$ ____________________________

117. Compute

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

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

118. Evaluate the sum of the following infinite series.

$$\sum_{n=0}^{\infty}(-1)^n\frac{5^{n+1}}{3^{2n}}$$

Answer:________________________________

119. Evaluate the sum of the following infinite series.

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

Answer:________________________________

120. Evaluate the sum of the following infinite series.

$$\sum_{n=1}^{\infty} \left(\frac{3^{n-1}}{4^n} + \frac{(-1)^{n+1}}{9^n} \right)$$

Answer:________________________________

121. Find the radius of convergence for the power series shown below.

$$\sum_{n=0}^{\infty} 3(-2x)^n$$

$R =$ ________________________________

122. Find the radius of convergence for the power series shown below.

$$\sum_{n=0}^{\infty} 3\left(7x^2\right)^n$$

$R =$ ______________________________

123. Express $f(x) = \dfrac{3}{1+2x}$ as a power series and determine it's radius of converge.

$\dfrac{3}{1+2x} =$ ______________________________

$R =$ ______________________________

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

$$\frac{x}{4+3x^2} = \rule{5cm}{0.4pt}$$

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

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

$$\int \sin(x^{3/2})\, dx = \rule{5cm}{0.4pt}$$

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

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

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

127. Evaluate the following indefinite integral as a series. [Leave your answer as a sum.]

$$\int 5e^{5x^3}\, dx$$

$\int 5e^{5x^3}\, dx =$ ________________________________

128. Use the first three terms of the powers series representation of the $f(x) = \dfrac{3x}{10+2x}$ to estimate $f(0.5)$. Round to 4 decimal places.

$f(0.5) \approx$ ______________________

129. Use a power series to approximate the definite integral using the first 3 terms of the series.

$$\int_0^{0.24} \frac{x}{5+x^6}\,dx$$

$\int_0^{0.24} \frac{x}{5+x^6}\,dx \approx$ ______________________________

130. Use a power series to approximate the definite integral using the first 4 terms of the series. Round to 5 decimal places.

$$\int_0^{0.11} \frac{1}{1+x^4}\,dx$$

$\int_0^{0.11} \frac{1}{1+x^4}\,dx \approx$ ______________________________

131. Use a power series to approximate the definite integral using the first 3 terms of the series. Round to 5 decimal places.

$$\int_0^{0.23} e^{-x^2}\,dx$$

$\int_0^{0.23} e^{-x^2}\,dx \approx$ ______________________________

132. Use a power series to approximate the definite integral using the first 4 terms of the series. Round to 5 decimal places.

$$\int_0^{0.45} 4x\cos(\sqrt{x})\,dx$$

$\int_0^{0.45} 4x\cos(\sqrt{x})\,dx \approx$ ____________________

133. Use the first 3 terms of the Macluarin series for $f(x) = \ln(1+x)$ to evaluate $ln(1.56)$. Round to 5 decimal places.

$\ln(1.56) \approx$ ____________________

134. Use the first 4 terms of the Macluarin series for $f(x) = \sin(x)$ to evaluate $\sin(0.75)$. Round to 5 decimal places.

$\sin(0.75) \approx$ ____________________

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

$f(3, -8) =$ ____________________

136. Find the domain of

$$f(x, y) = \frac{-5x}{\sqrt{x + 9y + 1}}$$

Domain = ____________________

137. Find the domain of

$$f(x,y) = \frac{\sqrt{x+y-1}}{\ln(y-11)-9}$$

Domain = ______________________________

138. Find the domain of

$$f(x,y) = \frac{\ln(x^2-y+3)}{\sqrt{x-6}}$$

Domain = ______________________________

139. Describe the indicated level curves $f(x, y) = C$

$$f(x, y) = \ln(x^2 + y^2) \;\; C = \ln(36)$$

(a) Parabola with vertices at $(0, 0)$
(b) Circle with center at $(0, \ln(36))$ and radius 6
(c) Parabola with vertices at $(0, \ln(36))$
(d) Circle with center at $(0, 0)$ and radius 6
(e) Increasing Logarithm Function

140. 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

141. 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

142. 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

143. For the following function $f(x,y)$, evaluate $f_y(-2,-3)$.

$$f(x,y) = 8x^4y^5 + 3x^3 - 12y^2$$

$f_y(-2,-3) =$ ______________________________

144. Compute $f_x(6,5)$ when

$$f(x,y) = \frac{(6x-6y)^2}{\sqrt{y^2-1}}$$

$f_x(6,5)=$ ______________________________

145. Find the first order partial derivatives of

$$f(x, y) = \frac{3x^2y^3}{(y-1)^2}$$

$f_x(x, y) =$ ________________________________

$f_y(x, y) =$ ________________________________

146. Find the first order partial derivatives of

$$f(x, y) = x \sin(xy)$$

$f_x(x, y) =$ ________________________________

$f_y(x, y) =$ ________________________________

147. Find the first order partial derivatives of $f(x,y) = (xy-1)^2$

$f_x(x,y) =$ ______________________

$f_y(x,y) =$ ______________________

148. Find the first order partial derivatives of $f(x,y) = xe^{x^2+xy+y^2}$

$f_x(x,y) =$ ______________________

$f_y(x,y) =$ ______________________

149. Find the first order partial derivatives of $f(x, y) = -7\tan(x^7y^8)$

$f_x(x, y) =$ ________________

$f_y(x, y) =$ ________________

150. Find the first order partial derivatives of $f(x, y) = y\cos(x^2y)$

$f_x(x, y) =$ ________________

$f_y(x, y) =$ ________________

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

$f_x(x, y) =$ ____________________

$f_y(x, y) =$ ____________________

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

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

153. Given the function $f(x, y) = 4x^5 \tan(3y)$, compute $f_{xy}(2, \pi/3)$

$f_{xy}(2, \pi/3) =$ ______________________

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

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

155. Find the second order partial derivatives of

$$f(x, y) = x^2 y \ln(7x)$$

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

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

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

156. A function $f(x, y)$ has 2 critical points. The partial derivatives of $f(x, y)$ are

$$f_x(x, y) = 8x - 16y \quad \text{and} \quad f_y(x, y) = 8y^2 - 16x$$

One of the critical points is $(0, 0)$. Find the second critical point of $f(x, y)$.

$(a, b) =$ ______________________

157. Find the discriminant of

$$f(x, y) = e^x \sin(y)$$

Simplify your answer. Note: $\sin^2(y) + \cos^2(y) = 1$.

$D(x, y) =$ ______________________

158. Using the information in the table below, classify the critical points for the function $g(x, y)$.

(a, b)	$g_{xx}(a, b)$	$g_{yy}(a, b)$	$g_{xy}(a, b)$
$(4, 5)$	0	4	-2
$(5, -10)$	5	-10	6
$(10, 10)$	-4	-6	-4
$(7, 9)$	5	7	4
$(4, 8)$	2	2	2

- (4,5) is ______________________
- (5,-10) is ______________________
- (10,10) is ______________________
- (7,9) is ______________________
- (4,8) is ______________________

159. 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: ______________________________

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

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

(a) Two saddle points and one local minimum
(b) Two saddle points and one local maximum
(c) One saddle point, one local maximum, and one local minimum
(d) Three saddle points
(e) Two local minimums and one saddle point

Answer:________________________

161. 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 ________________________

162. Find all local maximum and minimum points of

$$f(x,y) = 4x^2 - xy + 8y^2 - 46x - 26y + 11$$

Local max at ______________________

Local min at ______________________

163. Fleet feet stores two most sold running shoes brands are Aesics and Brookes. The total venue from selling x pairs of Aesics and y pairs of Brookes is given by

$$R(x,y) = -10x^2 - 16y^2 - 4xy + 84 + 204y$$

where x and y are in **thousands of units**. Determine the number of Brookes shoes to be sold to maximize the revenue.

The # of Brookes shoes sold is ____________

164. Find the point(s) (x, y) where the function $f(x, y) = 3x^2 + 4xy + 6x - 15$ attains maximal value, subject to the constraint $x + y = 10$.

(x,y) = ____________________

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

Maximum Value = ____________________

166. Find the minimum value of the function $f(x, y) = 2x^2y - 3y^2$ subject to the constraint $x^2 + 2y = 1$.

Minimum Value = ____________________

167. Locate and classify the points that maximize and minimize the function $f(x, y) = 5x^2 + 10y$ subject to the constraint $5x^2 + 5y^2 = 5$.

Minimum Value occurs at ____________________

Maximum Value occurs at ____________________

168. Find the maximum value of the function $f(x, y) = 8x - 11y^2$ subject to the constraint $x^2 + 11y^2 = 25$.

Max value is________________________

169. 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 = ____________

170. We are baking a tasty treat where customer satisfaction is given by $S(x, y) = 6x^{3/2}y$. Here, x and y are the amount of sugar and spice respectively. If the sugar and spice we use must satisfy $9x + y = 4$, what is the maximum customer satisfaction we can achieve? (Note: the function is defined only for $x \geq 0$ and $y \geq 0$.) Round your answer to 2 decimal places.

Maximum Value = ______________________________

171. A customer has \$280 to spend on two items, Item A, which costs \$2 per unit, and Item B, which costs \$5 per unit. If the enjoyment of each item by the customer is given by $f(A, B) = 100AB^3$, how many of each unit should be purchase to maximize the enjoyment of the customer?

Units of A: ______________________________

Units of B: ______________________________

172. Evaluate the following double integral.

$$\int_0^2 \int_0^3 (x+y)\,dy\,dx$$

$$\int_0^2 \int_0^3 (x+y)\,dy\,dx = \underline{\hspace{6cm}}$$

173. Evaluate the double integral

$$\int_0^{\pi/3} \int_0^2 25y^4 \sec^2(x)\,dy\,dx$$

$$\int_0^{\pi/3} \int_0^2 25y^4 \sec^2(x)\,dy\,dx = \underline{\hspace{4cm}}$$

174. Evaluate the double integral

$$\int_0^{\pi/2}\int_0^1 12x^3\sin(y)\,dx\,dy$$

$$\int_0^1\int_0^{\pi/2} 12x^3\sin(y)\,dx\,dy = \underline{\hspace{4cm}}$$

175. Evaluate the double integral

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

$$\int_0^1\int_0^{\pi/2} 16y^3\cos(x)\,dy\,dx = \underline{\hspace{4cm}}$$

176. Evaluate the double integral

$$\int_0^4 \int_2^y (y + x)\, dx\, dy$$

$$\int_0^4 \int_2^y (y + x)\, dx\, dy = \underline{\hspace{6cm}}$$

177. Evaluate the double integral

$$\int_1^2 \int_1^{x^2} \frac{x}{y^2}\, dy\, dx$$

$$\int_1^2 \int_1^{x^2} \frac{x}{y^2}\, dy\, dx = \underline{\hspace{6cm}}$$

178. Compute the following definite integral.

$$\int_0^7 \int_1^x 36x \, dy \, dx$$

$$\int_0^7 \int_1^x 36x \, dy \, dx = \underline{\hspace{4cm}}$$

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

Answer:____________________

180. Switch the order of integration on the follow integral

$$\int_0^6 \int_{x^2}^{36} f(x, y)\, dy\, dx$$

Answer: ______________________________

181. Switch the order of integration on the follow integral

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

Answer: ______________________________

182. Evaluate the double integral

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

(Hint: Change the order of integration)

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

183. Evaluate the double integral

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

Round your answer to 2 decimal places.

(Hint: Change the order of integration)

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

184. Evaluate the double integral

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

(Hint: Change the order of integration)

$$\int_0^1 \int_y^1 2e^{x^2}\, dx\, dy = \underline{\hspace{6cm}}$$