1. Choose the expression equivalent to $\ln \frac{9x^2}{2y}$.

a. $\ln 9 - \ln 2 + 2 \ln x - \ln y$
b. $2 \ln(9x) - \ln(2y)$
c. $\ln(9x^2) + \ln(2y)$
d. None of these
e. $\frac{\ln 9 + \ln x^2}{\ln 2 + \ln y}$

2. Find the derivative: $f(x) = \ln \frac{x^2\sqrt{4x + 1}}{(x^3 + 5)^3}$.

a. $\frac{x}{9x^2(x^3 + 5)^2 \sqrt{4x + 1}}$
b. $\frac{2}{x} - \frac{2}{4x + 1} - \frac{9x^2}{x^3 + 5}$
c. $\frac{2}{x} + \frac{1}{2(4x + 1)} - \frac{3}{x^3 + 5}$
d. $\frac{2}{x} + \frac{2}{4x + 1} - \frac{9x^2}{x^3 + 5}$
e. None of these

3. Find the derivative: $f(x) = \ln \frac{x(x^2 + 2)}{\sqrt{x^3 - 7}}$.

a. $\frac{x^2 + 2}{x} + \frac{2x^2}{x^2 + 2} - \frac{3x^2}{2(x^3 - 7)}$
b. None of these
c. $\frac{1}{x} + \frac{2x}{x^2 + 2} - \frac{3x^2}{2(x^3 - 7)}$
d. $\frac{x^2 + 2}{x} + \frac{2x^2}{x^2 + 2} + \frac{3x^2}{2(x^3 - 7)}$
e. $\frac{1}{x} + \frac{2x}{x^2 + 2} + \frac{3x^2}{2(x^3 - 7)}$

4. Solve for x: $\ln(5x + 1) + \ln x = \ln 4$.
   a. e^4, $e^{3/5}$
   b. None of these
   c. $\frac{4}{5}$
   d. $\frac{3}{5}$, 4
   e. -1, $\frac{4}{5}$

5. Use logarithmic differentiation to find $\frac{dy}{dx}$: $y = \frac{x^3\sqrt{2x + 3}}{(x - 2)^2}$.

6. Find an equation for the tangent line to the graph of $f(x) = \ln(x^2 - 1)$ at the point where $x = 2$.
   a. $4x - 3y = -1$
   b. $4x - 3y = 8 - \ln 27$
   c. None of these
   d. $4x - y = 8 - \ln 3$
   e. $4x - 3y = 8$

7. Evaluate the definite integral: $\int_1^{\sqrt{e}} \frac{-4x}{x^2}\, dx$.
   a. -2
   b. -4
   c. None of these
   d. -6
   e. -1

8. Evaluate the integral: $\int \frac{2x + 1}{x + 1}\, dx$.
   a. None of these
   b. $2x + C$
   c. $x^2 + \ln|x + 1| + C$
   d. $\frac{2x^2 + 2x}{x^2 + 2x} + C$
   e. $2x - \ln|x + 1| + C$

9. Evaluate the integral: $\int \frac{8x^2 + 9x + 8}{x^2 + 1}\, dx$.

a. None of these
b. $8x + 9 \ln(x^2 + 1) + C$
c. $8x + \frac{9}{2} \ln(x^2 + 1) + C$
d. $8 + \frac{9}{2} \ln(x^2 + 1) + C$
e. $8 + 9 \ln(x^2 + 1) + C$

10. Evaluate the integral: $\int \tan 3x\, dx$.

a. $\frac{1}{3} \ln|\sec 3x| + C$
b. None of these
c. $\ln|\cos 3x| + C$
d. $3 \sec^2 3x + C$
e. $\frac{1}{3} \sec^2 3x$

11. Evaluate the integral: $\int \frac{\sin^2 x - \cos^2 x}{\sin x}\, dx$.

a. $-2 \cos x + \ln|\csc x + \cot x| + C$
b. $-\ln|\csc x + \cot x| + C$
c. $-\sec x + C$
d. None of these
e. $\cos x + \ln|\csc x + \cot x| + C$

12. Evaluate the integral: $\int \frac{t^2 + 1}{t + 1}\, dt$.

a. $\frac{t^2 - 2t - 1}{(t + 1)^2} + C$
b. $\frac{1}{2}t^2 - t + \ln(t + 1)^2 + C$
c. None of these
d. $t^2 - 2t + \ln(t + 1)^4 + C$
e. $t + C$

13. Solve the differential equation: $\frac{ds}{dt} = \frac{\sec t \tan t}{\sec t + 5}$.

a. $s = \frac{1}{5} \ln |\sec t| + C$

b. None of these

c. $s = \ln |\sec t + 5| + C$

d. $s = \frac{1}{5} \tan t + C$

e. $s = 2 \sec^3 t - \sec t + C$

14. A population of bacteria is changing at the rate of $\frac{dP}{dt} = \frac{2000}{1 + 0.2t}$, where t is the time in days. The initial population is 1000.

a. Write an equation that gives the population at any time t.

b. Find the population after 10 days.

15. Determine whether the function $f(x) = \frac{7}{x + 2}$ is one-to-one. If it is, find its inverse.

a. $f^{-1}(x) = \frac{7}{x + 2}$

b. Not one-to-one

c. None of these

d. $f^{-1}(x) = \frac{7 - 2x}{x}$

e. $f^{-1}(x) = \frac{x + 2}{7}$

16. Let $f(x) = \sqrt{3x^3 - 1}$. Calculate $f^{-1}(x)$.

a. $\sqrt{\dfrac{3}{x^3} - 1}$

b. $\sqrt[3]{\dfrac{x^2}{3} + 1}$

c. $\dfrac{1}{\sqrt{3x^3 - 1}}$

d. None of these

e. $\sqrt[3]{\dfrac{x^2 + 1}{3}}$, $x \geq 0$

17. Determine whether $f(x) = \dfrac{x - b}{a}$ is one-to-one; if it is, find f^{-1}.

a. $\dfrac{x - a}{b}$

b. f is not one-to-one

c. $ax + b$

d. $\dfrac{a}{x - b}$

e. None of these

18. Find $(f^{-1})'(12)$ for the function $f(x) = \dfrac{1}{3}x^3 + \dfrac{5}{3}x + 2$.

19. Find $f'(x)$ for $f(x) = \sqrt{4 + e^{2x}}$.

a. $\dfrac{1}{2\sqrt{2e^{2x}}}$

b. $\dfrac{e^{2x}}{\sqrt{4 + e^{2x}}}$

c. e^{x}

d. $\dfrac{xe^{2x-1}}{\sqrt{4 + e^{2x}}}$

e. None of these

20. Find the slope of the tangent line to the graph of $y = (\ln x)e^{x}$ at the point where $x = 2$.

a. $e^{2}\left(\ln 2 + \dfrac{1}{2}\right)$

b. None of these

c. $e(2 \ln 2 + 1)$

d. e

e. $\dfrac{1}{2}e^{2}$

21. Evaluate the integral: $\displaystyle\int \frac{e^{\sqrt{x}}}{\sqrt{x}}\, dx$.

a. $2e^{\sqrt{x}} + C$

b. $\sqrt{x}\, e^{\sqrt{x}} + C$

c. $\dfrac{1}{2}e^{\sqrt{x}} + C$

d. $\sqrt{x}\, e^{\sqrt{x+1}} + C$

e. None of these

22. Evaluate the indefinite integral: $\int \frac{1}{x^2 e^{2/x}}\, dx$.

a. $\frac{1}{2}e^{2/x} + C$

b. $\frac{1}{2}e^{-2/x} + C$

c. $\frac{1}{2}xe^{-2/x} + C$

d. $\frac{1}{2}xe^{2/x} + C$

e. None of these

23. Calculate the area of the region bounded by $y = e^{2x}$, $y = 0$, $x = 1$, $x = 4$.

24. Evaluate the integral: $\int e^{(ax+b)}\, dx$.

a. $ae^{(ax+b)} + C$

b. None of these

c. $\frac{1}{a}e^{(ax+b)} + C$

d. $e^{(ax+b)} + C$

e. $e^{(ax^2/2+bx+c)}$

25. Find $\frac{dy}{dx}$ if $y = \frac{x^3}{3^x}$.

a. $\frac{3x^2}{3^x(\ln 3)}$

b. None of these

c. $\frac{x}{3^{x-2}}$

d. $\frac{x^2(9 - x^2)}{3^{x+1}}$

e. $\frac{x^2[3 - x(\ln 3)]}{3^x}$

26. Differentiate: $y = x^{e^x}$.

a. $x^{e^x}\left[\dfrac{e^x}{x} + (\ln x)(e^x)\right]$

b. $e^x x^{e^{x-1}}$

c. e^x

d. $xe^x + e^x$

e. None of these

27. Find the area bounded by the function $f(x) = 2^{-x}$, the x-axis, $x = -2$, and $x = 1$.

28. If an annual rate of salary increase averages 4.5% over the next 5 years, then the approximate salary, S, during any year in that period is $S(t) = P(1.045)^t$ where t is the time in years and P is the present salary.

a. If a person's salary is \$30,000 now, use the function S to estimate her salary 5 years from now.

b. Use the model given to estimate how long it will be before this individual earns \$50,000.

c. Find the rate of change of S with respect to t when $t = 1$ and when $t = 4$.

29. A certain type of bacteria increases continuously at a rate proportional to the number present. If there are 500 present at a given time and 1000 present 2 hours later, how many will there be 5 hours from the initial time given?

a. None of these
b. 1750
c. 2828
d. 3000
e. 2143

30. A certain type of bacteria increases continuously at a rate proportional to the number present. If there are 500 present at a given time and 1000 present 2 hours later, how many hours (from the initial given time) will it take for the numbers to be 2500? Round your answer to 2 decimal places.

31. Solve the differential equation: $2y' = y$.

a. $y = Ce^{x/2}$

b. $y = e^{2x} + C$

c. $2y = \dfrac{y^2}{2} + C$

d. None of these

e. $y = e^{x/2} + C$

32. Find the function $y = f(x)$ passing through the point (0, 6) that has the first derivative $\dfrac{dy}{dx} = y - 2$.

33. Use integration to find a general solution to the differential equation $y' = \dfrac{2}{\sqrt{1 - x^2}} + x$.

a. $\arcsin\left(\dfrac{x}{2}\right) + C$

b. $2 \arcsin x + x^2 + C$

c. None of these

d. $2 \arcsin x + \dfrac{x^2}{2} + C$

e. $2 \arcsin x^2 + \dfrac{x^2}{2} + C$

34. Use integration to find a general solution to the differential equation $\dfrac{dy}{dx} = \dfrac{3}{1 + x^2}$.

35. A colony of bacteria increases at a rate proportional to the number present. If there were 1000 bacteria present in the beginning of the experiment and the number triples in four hours, determine the number present as a function of time.

36. Find the general solution of the differential equation $y' = \dfrac{\sin x}{\cos y}$.

a. $\sin y = C \cos x$

b. $\sin y + \cos x = C$

c. $\sin y - \cos x = C$

d. $\tan y = C$

e. None of these

37. Find the particular solution of the differential equation $\frac{dy}{dx} = 500 - y$ that satisfies the initial condition $y(0) = 7$.

38. Evaluate: $\arccos\left(-\frac{1}{2}\right)$.

a. $\frac{2\pi}{3}$
b. $\frac{\pi}{3}$
c. $\frac{\pi}{6}$
d. None of these
e. $-\frac{\pi}{3}$

39. Evaluate: $\cos\left[\arctan\left(-\frac{2}{3}\right)\right]$.

a. $-\frac{2\sqrt{13}}{13}$
b. None of these
c. $\frac{2\sqrt{13}}{13}$
d. $-\frac{3\sqrt{13}}{13}$
e. $\frac{3\sqrt{13}}{13}$

40. Find the exact value: $\cos\left[\arctan\left(-\frac{3}{10}\right)\right]$.

41. Write an algebraic expression for tan [arcsin x].

a. $\dfrac{x\sqrt{1 + x^2}}{1 + x^2}$

b. $\dfrac{x\sqrt{1 - x^2}}{1 - x^2}$

c. None of these

d. $\dfrac{1}{x}$

e. $\dfrac{\sqrt{1 - x2}}{x}$

42. Differentiate: $f(x) = \arcsin \sqrt{1 - 36x^2}$.

a. $-\dfrac{6}{1 - 36x^2}$

b. $\dfrac{6x}{|x|\sqrt{1 - 36x^2}}$

c. $\dfrac{6x}{|x|\sqrt{1 - 36x^2}}$

d. $\dfrac{6}{1 - 36x^2}$

e. None of these

43. Find the derivative: $g(x) = \operatorname{arcsec} \frac{x}{2}$.

a. $\frac{1}{\sqrt{4 - x^2}}$

b. $\frac{1}{\sqrt{x^2 - 4}}$

c. $\frac{4}{x\sqrt{x^2 - 4}}$

d. None of these

e. $\frac{2}{x\sqrt{x^2 - 4}}$

44. Evaluate: $\int \frac{x + 2}{\sqrt{4 - x^2}}\, dx$.

a. $x^2 + 2x + \arcsin \frac{x}{2} + C$

b. $\ln|2 - x| + C$

c. $-\frac{1}{2}\sqrt{4 - x^2} + 2 \arcsin \frac{x}{2} + C$

d. $-\sqrt{4 - x^2} + 2 \arcsin \frac{x}{2} + C$

e. None of these

45. Evaluate: $\int \frac{5}{x^2 + 6x + 13}\, dx$.

a. $5\left(\frac{x^3}{3} + 3x^2 + 13x\right) + C$

b. $\frac{5}{2} \arctan \frac{x + 3}{2} + C$

c. None of these

d. $5 \ln|x^2 + 6x + 13| + C$

e. $-\frac{5}{x} + \frac{5}{6} \ln|x| + \frac{5}{13}x + C$

46. Find the indefinite integral: $\int \frac{x}{16 + x^4}\, dx$.

a. None of these

b. $\frac{1}{8} \operatorname{arcsec} \frac{x^2}{4} + C$

c. $\frac{1}{2} \arcsin \frac{x^2}{4} + C$

d. $\frac{1}{4} \arctan \frac{x^2}{4} + C$

e. $\frac{1}{8} \arctan \frac{x^2}{4} + C$

47. Evaluate the integral: $\int \frac{1}{2x\sqrt{4x^2 - 1}}\, dx$.

a. $\frac{1}{2} \arcsin |2x| + C$

b. $\frac{1}{2} \operatorname{arcsec} |2x| + C$

c. $\frac{1}{8}\sqrt{4x^2 - 1} + C$

d. $\operatorname{arcsec} |2x| + C$

e. None of these

48. Evaluate the definite integral: $\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{3}{\sqrt{4 - 9x^2}}\, dx$.

49. Evaluate the integral: $\int \frac{(\arctan x)^3}{1 + x^2}\, dx$.

a. $\frac{3(\arctan x)^2}{(1 + x^2)^2} + C$

b. None of these

c. $\frac{1}{4}(\arctan x)^5 + C$

d. $\frac{1}{4}(\arctan x)^4 + C$

e. $\frac{3(\arctan x)^2}{2x(1 + x^2)} + C$

50. Evaluate the definite integral: $\int_1^4 \frac{1}{x^2 - 2x + 10}\, dx$.

a. $-\frac{\pi}{4}$

b. $\frac{\pi}{12}$

c. 1.249

d. -0.0419

e. None of these

51. Consider $f(x) = \frac{1}{4 + 9x^2}$.

a. Use a graphing utility to graph f.

b. Sketch the region bounded by f, the x-axis, and the line $x = 1$ and $x = 2$.

c. Write the integral that represents the area of the region.

d. Calculate the area.

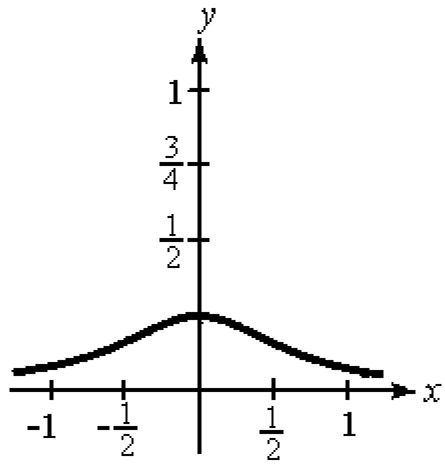
1. a
2. d
3. d
4. c
5. $$y\left[\frac{3}{x}+\frac{1}{2x+3}-\frac{2}{x-2}\right]=\frac{x^3\sqrt{2x+3}}{(x-2)^2}\left[\frac{3}{x}+\frac{1}{2x+3}-\frac{2}{x-2}\right]$$
6. b
7. a
8. e
9. c
10. a
11. a
12. b
13. c
14. **a.** $P = 10{,}000 \ln(1 + 0.2t) + 1000$
    b. $10{,}000 \ln 3 + 1000 \approx 11{,}986$
15. d
16. e
17. c
18. $\frac{3}{32}$
19. b
20. a
21. a
22. b
23. $\frac{1}{2}e^2(e^6 - 1)$
24. c
25. e
26. a
27. $\frac{7}{2 \ln 2}$
28. **a.** $37,385.46
    b. 11.6 years
    c. 1379.93, 1574.73
29. c
30. 4.64
31. a
32. $y = 4e^x + 2$
33. d
34. $y = 3 \arctan x + C$
35. $y = 1000e^{(t \ln 3)/4}$
36. b
37. $y = 500 - 493e^{-x}$
38. a
39. e

40. $\frac{10\sqrt{109}}{109}$

41. b
42. b
43. e
44. d
45. b
46. e
47. b
48. $\frac{2\pi}{3}$

49. d
50. b
51.
   a. See graph below.
   b. See graph below.
   c. $\int_1^2 \frac{1}{4 + 9x^2} dx$
   d. $\frac{1}{6}\left(\arctan 3 - \arctan \frac{3}{2}\right) \approx 0.0444$

a.



b.