MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) The pH scale is used by chemists to measure the acidity of a solution. It is a base 10 logarithmic scale. The pH, P, of a solution is defined as

\[ P = -\log_{10}H, \]

where \( H = [H_3O^+] \) is the hydronium ion concentration in moles per liter. Find the rate of change \( \frac{dP}{dH} \).

A) \( \frac{dP}{dH} = -\frac{\ln 10}{H} \)
B) \( \frac{dP}{dH} = -\frac{1}{H \ln 10} \)
C) \( \frac{dP}{dH} = -\frac{1}{H \ln H} \)
D) \( \frac{dP}{dH} = -\frac{1}{H} \)

2) Find the present value of $36,000 due 17 years later at 7.1%, compounded continuously.

A) $173,913.04
B) $120,363.81
C) $10,767.36
D) $10,153.62

3) A business estimates that the salvage value \( V \) of a piece of machinery after \( t \) years is given by

\[ V(t) = 27,000e^{-0.4t}. \]

After what amount of time will the salvage value be $681?

A) After 10.2 years
B) After 11.2 years
C) After 8.2 years
D) After 9.2 years

4) A radioactive substance has a half-life of 474 years. What is its decay rate?

A) 0.00169% per year
B) 0.0844% per year
C) 0.00146% per year
D) 0.146% per year

5) How old is a skeleton that has lost 41% of its carbon-14? The decay rate, \( k \), of carbon-14 is 0.01205% per year.

A) 4379 years
B) 2931 years
C) 7399 years
D) 44 years

6) An artifact is discovered at a certain site. If it has 63% of the carbon-14 it originally contained, what is the approximate age of the artifact to the nearest year? (carbon-14 decays at the rate of 0.0125% annually.)

A) 5040 years
B) 3696 years
C) 1605 years
D) 2960 years
7) Following the birth of a child, a parent wants to make an initial investment \( P_0 \) that will grow to $50,000 by the child's 20th birthday. Interest is compounded continuously at 7.4\%. What should the initial investment be?

A) $10,812.79  
B) $219,647.28  
C) $11,381.88  
D) $20,161.29

Differentiate.

8) \( f(x) = 2 \log x \)
   A) \( \frac{2}{x \ln(x)} \)  
   B) \( \frac{2 \ln(10)}{x} \)  
   C) \( \frac{2}{x \ln(10)} \)  
   D) \( \frac{1}{x \ln(2)} \)

9) \( f(x) = \log \frac{x}{5} \)
   A) \( \frac{1}{5x \ln(10)} \)  
   B) \( \frac{5}{x \ln(10)} \)  
   C) \( \frac{1}{x \ln(10)} \)  
   D) \( \frac{1}{5x \ln(x)} \)

10) \( f(x) = x^5 \log_7 x \)
    A) \( \frac{5x^3}{\ln(7)} \)  
    B) \( x^4 + 5x^4 \log_7 x \)  
    C) \( \frac{x^4}{\ln(7)} + 5x^4 \log_7 x \)  
    D) \( (\ln 7)x^4 + 5x^4 \log_7 x \)

11) \( f(x) = e^x \log_4 x \)
    A) \( e^x \left( \frac{\ln 4}{x} + \log_4 x \right) \)  
    B) \( e^x \left( \frac{1}{x} + \log_4 x \right) \)  
    C) \( e^x \left( \frac{1}{x \ln(4)} + \log_4 x \right) \)  
    D) \( \frac{e^x}{x \ln(4)} \)

12) \( y = 10^{11x} \)
    A) \( 110 \cdot (\ln 11) \cdot 10^{11x} \)  
    B) \( 11 \cdot (\ln 10) \cdot 10^{11x} \)  
    C) \( 10 \cdot (\ln 11) \cdot 10^{11x} \)  
    D) \( 110 \cdot (\ln 10) \cdot 10^{11x} \)

13) \( y = 21^{-x} \)
    A) \( -\ln 21 \cdot 21^{-x} \)  
    B) \( -21^{-x} \)  
    C) \( \ln 21 \cdot 21^{-x} \)  
    D) \( 21^{-x} \)

14) \( y = 7x^2 \)
    A) \( 7x^2 \cdot 2x \cdot \ln 7 \)  
    B) \( 7x^2 \cdot 2x \cdot \ln x \)  
    C) \( 7x^2 \cdot x \cdot \ln 7 \)  
    D) \( 2x \ln(7) \)

15) \( y = \log_5 x \)
    A) \( \frac{1}{x \ln(x)} \)  
    B) \( \frac{1}{x \ln(5)} \)  
    C) \( \frac{1}{x \log(5)} \)  
    D) \( \frac{\ln 5}{x} \)

16) \( y = 8x^2 \)
    A) \( 2x \ln 8x + x \)  
    B) \( x^2 \ln 8x \)  
    C) \( 8x^2(2x \ln 8x) \)  
    D) \( 8x^2(2x \ln 8x + x) \)
Find the elasticity.

17) \( q = D(x) = 500 - x \)
   A) \( E(x) = \frac{1}{500 - x} \)
   B) \( E(x) = x(500 - x) \)
   C) \( E(x) = \frac{x}{x - 500} \)
   D) \( E(x) = \frac{x}{500 - x} \)

18) \( q = D(x) = \frac{1200}{x} \)
   A) \( E(x) = \frac{1}{x} \)
   B) \( E(x) = \frac{x}{1200} \)
   C) \( E(x) = \frac{1200}{x} \)
   D) \( E(x) = 1 \)

19) \( q = D(x) = \frac{332}{(4x + 3)^2} \)
   A) \( E(x) = \frac{8x}{4x + 3} \)
   B) \( E(x) = 8x(4x + 3) \)
   C) \( E(x) = \frac{8}{4x + 3} \)
   D) \( E(x) = \frac{2x}{4x + 3} \)

For the given demand function, find the value(s) of \( x \) for which total revenue is a maximum.

20) \( x = D(x) = 500 - x \)
   A) 200
   B) 1000
   C) 500
   D) 250

21) \( x = D(x) = \frac{300}{x} \)
   A) All values of \( x \)
   B) 3
   C) 600
   D) 300

22) \( x = D(x) = \frac{600}{x} \)
   A) All values of \( x \)
   B) 1200
   C) 600
   D) 6

For the demand function given, find the elasticity at the given price and state whether the demand is elastic, inelastic, or whether it has unit elasticity.

23) \( q = D(x) = 600 - x; \quad x = 91 \)
   A) \( \frac{91}{509}; \) elastic
   B) \( \frac{1}{509}; \) inelastic
   C) \( \frac{91}{509}; \) inelastic
   D) 509; elastic

24) \( q = D(x) = \frac{1500}{x}; \quad x = 49 \)
   A) \( \frac{49}{1500}; \) elastic
   B) \( \frac{1500}{49}; \) inelastic
   C) 1; unit elasticity
   D) \( \frac{1}{49}; \) inelastic

25) \( q = D(x) = \sqrt{600 - x}; \quad x = 560 \)
   A) 14; elastic
   B) 7; elastic
   C) 1; unit elasticity
   D) 7; inelastic
26) \( q = D(x) = \frac{336}{(4x + 19)^2}; \ x = 1 \)

A) \( \frac{4}{23}; \) elastic  
B) \( \frac{2}{23}; \) inelastic  
C) \( \frac{8}{23}; \) inelastic  
D) 1; unit elasticity

27) \( q = D(x) = 900 - x; \ x = 110 \)

A) \( \frac{11}{79}; \) inelastic  
B) \( \frac{11}{79}; \) elastic  
C) 790; elastic  
D) \( \frac{1}{790}; \) inelastic

Evaluate the indefinite integral.

28) \( \int \frac{3}{\sqrt{64x^2}} \, dx \)

A) \( \frac{8}{3}x^{0/3} + C \)  
B) \( \frac{20}{3}x^{5/3} + C \)  
C) \( \frac{12}{5}x^{5/3} + C \)  
D) \( \frac{4}{3}x^{3} + C \)

29) \( \int 23x^{1/4} \, dx \)

A) 23x^{5/4} + C  
B) \( \frac{92}{5}x^{5/4} + C \)  
C) \( \frac{23}{5}x^{5} + C \)  
D) \( \frac{23}{4}x^{5/4} + C \)

30) \( \int (x - 3)^2 \, dx \)

A) \( \frac{1}{3}x^{3} + 9x + C \)  
B) \( \frac{1}{3}x^{3} - 3x^{2} + 9x + C \)  
C) \( \frac{1}{3}x^{3} + 3x^{2} - 9x + C \)  
D) 3x^{3} - 12x^{2} + 9x + C

Solve the problem.

31) A special-events promoter sells x tickets and has a marginal-revenue function given by 
\[ R'(x) = 2x - 1240, \] where \( R'(x) \) is in dollars per ticket. 
This means that the rate of change of total revenue with respect to the number of tickets sold, \( x \), is \( R'(x) \). Find the total revenue from the sale of the first 340 tickets.

A) \$306,000  
B) \$612,000  
C) \$115,600  
D) \$462,800

Write summation notation for the expression.

32) \( 7 + 14 + 21 + 28 + 35 \)

A) \( \sum_{i=7}^{35} 7i \)  
B) \( \sum_{i=1}^{5} 7i \)  
C) \( \sum_{i=7}^{35} i \)  
D) \( \sum_{i=1}^{7} 5i \)

33) \( 9 + 18 + 27 + 36 + 45 \)

A) \( \sum_{i=1}^{9} 5i \)  
B) \( \sum_{i=9}^{45} 9i \)  
C) \( \sum_{i=9}^{i=9} i \)  
D) \( \sum_{i=1}^{5} 9i \)
34) \( f(x_1) + f(x_2) + f(x_3) + f(x_4) + f(x_5) + f(x_6) \)

A) \( \sum_{i=1}^{6} f(x_i) \)
B) \( \sum_{i=x_1}^{x_6} i \)
C) \( \sum_{i=1}^{6} f(i) \)
D) \( \sum_{i=x_1}^{x_6} f(i) \)

Express the sum without using summation notation.

35) \( \sum_{i=1}^{5} 4i \)

A) \( 1 + 2 + 3 + 4 + 5 \)
B) \( 4 + 8 + 12 + 16 + 20 \)
C) \( 4 + 20 \)
D) \( 4 + 4 + 4 + 4 + 4 \)

36) \( \sum_{i=1}^{6} h(x_i) \)

A) \( h(x) + 2h(x) + 3h(x) + 4h(x) + 5h(x) + 6h(x) \)
B) \( h(x_1) + h(x_2) + h(x_3) + h(x_4) + h(x_5) + h(x_6) \)
C) \( x + 2x + 3x + 4x + 5x + 6x \)
D) \( h(1) + h(2) + h(3) + h(4) + h(5) + h(6) \)

Approximate the area under the graph of \( f(x) \) over the specified interval by dividing the interval into the indicated number of subintervals and using the left endpoint of each subinterval.

37) \( f(x) = \frac{1}{x^2}; \) interval \([1, 5]\); 4 subintervals

A) 1.4636
B) 0.4636
C) 2.0833
D) 1.4236

38) \( f(x) = x^2 + 2; \) interval \([0, 5]\); 5 subintervals

A) 66
B) 32
C) 65
D) 40

39) \( f(x) = 0.02x^3 + 11; \) interval \([-8, 0]\); 4 subintervals

A) 38.24
B) 56.00
C) 76.48
D) 28.00

40) \( f(x) = 0.2x^3 + 0.3x^2 - 0.5x + 10; \) interval \([-4, -1]\); 3 subintervals

A) 34.0
B) 6.0
C) 23.4
D) 30.0

41) \( f(x) = -0.02x^4 - 0.2x^2 + 10; \) interval \([-4, 4]\); 4 subintervals

A) 30.28
B) 60.56
C) 58.88
D) 29.44
Find the area under the given curve over the indicated interval.

42) \( y = 7; \ [2, 9] \)

Evaluate the definite integral and interpret the result.

43) \( \int_{-2}^{1} (x^3 - 4x) \, dx \)
44) \[ \int_{-1}^{1} (x^2 - x^4) \, dx \]

A) \( \frac{4}{15} \); the area bounded by the x-axis and the graph of \( y = x^2 - x^4 \) is \( \frac{4}{15} \).

B) \( -\frac{2}{15} \); the area bounded by the x-axis and the graph of \( y = x^2 - x^4 \) is \( -\frac{2}{15} \).

C) \( -\frac{1}{15} \); the area bounded by the x-axis and the graph of \( y = x^2 - x^4 \) is \( -\frac{1}{15} \).

D) \( \frac{2}{15} \); the area bounded by the x-axis and the graph of \( y = x^2 - x^4 \) is \( \frac{2}{15} \).

Find the area under the graph of the function over the interval given.

45) \( y = \frac{2}{x} \); [1, 8]
   A) \( 8 \ln 2 \)  
   B) \( \ln 16 \)  
   C) \( 2 \ln 8 \)  
   D) \( \ln 8 \)

46) \( y = 2x + 7 \); [1, 5]
   A) 9  
   B) 18  
   C) 26  
   D) 52

47) \( y = 2x - x^2 \); [0, 2]
   A) \( \frac{2}{3} \)  
   B) \( \frac{7}{3} \)  
   C) \( \frac{4}{3} \)  
   D) \( \frac{5}{3} \)

48) \( y = x^2 + 1 \); [0, 1]
   A) \( \frac{2}{3} \)  
   B) \( \frac{4}{3} \)  
   C) \( \frac{1}{3} \)  
   D) \( \frac{5}{3} \)

49) \( y = \frac{9}{x} \); [1, 8]
   A) \( \ln 8 \)  
   B) \( 8 \ln 9 \)  
   C) \( 9 \ln 8 \)  
   D) \( \ln 72 \)

50) \( y = e^x \); [-9, 3]
   A) \( e^3 + e^9 \)  
   B) \( e^3 - e^9 \)  
   C) \( e^{12} \)  
   D) \( e^3 - \frac{1}{e^9} \)
Evaluate the definite integral and interpret the result.

51) \[ \int_{0}^{3} (4 - x^2) \, dx \]

A) 5; the total shaded area is equal to 5.
B) \( \frac{23}{3} \); the total shaded area is equal to \( \frac{23}{3} \).
C) \( \frac{23}{3} \); the shaded area above the x-axis minus the shaded area below the x-axis is equal to \( \frac{23}{3} \).
D) 3; the shaded area above the x-axis minus the shaded area below the x-axis is equal to 3.

52) \[ \int_{-3}^{3} (x^3 - 9x) \, dx \]

A) 9; the shaded area above the x-axis minus the shaded area below the x-axis equals 9.
B) 0; the shaded area above the x-axis is equal to the shaded area below the x-axis.
C) 81; the shaded area above the x-axis plus the shaded area below the x-axis equals 81.
D) 81; the shaded area above the x-axis minus the shaded area below the x-axis equals 81.
53) \[ \int_{0}^{3} (4 - x^2) \, dx \]

A) \( \frac{23}{3} \); the total shaded area is equal to \( \frac{23}{3} \).
B) 3; the shaded area above the x-axis minus the shaded area below the x-axis is equal to 3.
C) \( \frac{23}{3} \); the shaded area above the x-axis minus the shaded area below the x-axis is equal to \( \frac{23}{3} \).
D) 5; the total shaded area is equal to 5.

Solve the problem.

54) A manufacturer determined that its marginal cost per unit produced is given by the function

\[ C'(x) = 0.0006x^2 - 0.4x + 94. \]

Find the total cost of producing the 401st unit through the 500th unit.

A) $3569.96 
B) $3600 
C) $9700 
D) $15,800

55) A well-drilling company finds that its marginal profit, in dollars, from drilling a well that is x feet deep is given by

\[ P'(x) = \frac{3}{\sqrt{x}}. \]

Find the company’s profit from drilling a well that is 230 feet deep.

A) $1409.19 
B) $2325.42 
C) $1056.89 
D) $1878.92

56) The time required for workers to produce each unit of a product decreases as the workers become more familiar with the production procedure. It is determined that the function for the learning process is

\[ T(x) = 2 + 0.3 \left( \frac{1}{x} \right), \]

where \( T(x) \) is the time, in hours, required to produce the xth unit. Find the time required for a new worker to produce units 10 through 17.

A) -2.84 hr 
B) 34.85 hr 
C) 14.16 hr 
D) 32.85 hr

57) A particle is released during an experiment. Its speed t minutes after release is given by

\[ v(t) = -0.25t^2 + 8t, \]

where \( v(t) \) is in kilometers per minute. How far does the particle travel during the first 12 minutes?

A) 60.00 km 
B) 720.00 km 
C) 576 km 
D) 432.00 km
58) The magnitude $R$ (measured on the Richter scale) of an earthquake of intensity $I$ is defined as

$$R = \log \frac{I}{I_0}$$

where $I_0$ is a minimum intensity used for comparison. What is the magnitude on the Richter scale of an earthquake whose intensity, $I$, is $10^4 I_0$?

A) 9.2  B) 4 $I_0$  C) 4  D) 0.6

Evaluate.

59) $\int_0^b 3e^x \, dx$

A) $3e^b - 1$  B) $3e^b - 3$  C) $3e^b$  D) $\frac{3e^b + 1}{b + 1} - \frac{e}{2}$

60) $\int_0^1 \frac{x^3 + 1}{x + 1} \, dx$

A) $\frac{4}{3}$  B) $\frac{11}{6}$  C) 1  D) $\frac{5}{6}$

61) $\int_0^3 (4x + 3)(5x - 1) \, dx$

A) 120  B) $\frac{441}{2}$  C) 51  D) 630

62) $\int_0^3 (x + 3)^3 \, dx$

A) $\frac{1215}{4}$  B) 81  C) 1215  D) 324

63) $\int_4^5 \frac{x^2 - 16}{x - 4} \, dx$

A) 13  B) $\frac{1}{2}$  C) $\frac{13}{2}$  D) $\frac{17}{2}$

64) $\int_1^3 \frac{x^5 - x^{-1}}{x^2} \, dx$

A) $\frac{704}{9}$  B) $\frac{731}{36}$  C) $\frac{176}{9}$  D) $\frac{1403}{72}$
65) \( \int_{1}^{4} \frac{t^2 + 1}{\sqrt{t}} \, dt \)

A) \( \frac{92}{5} \)  
B) 32  
C) \( \frac{72}{5} \)  
D) \( \frac{77}{5} \)

66) \( \int_{1}^{e} \frac{7}{x} \, dx \)

A) 7  
B) 0  
C) \( \frac{7}{2}e^2 \)  
D) −7

67) \( \int_{1}^{e} \left( 20x - \frac{9}{x} \right) \, dx \)

A) 10e^2 − 10  
B) 20e^2 − 9  
C) 10e^2 − 9  
D) 10e^2 − 19

Find the area under the given curve over the indicated interval.

68) \( y = 2x + 1; \ [1, 3] \)

A) 12.5  
B) 10  
C) 7.5  
D) 5
69) \( y = x^2 + 3; \ [0, 2] \)

A) \( \frac{23}{3} \)  
B) \( \frac{26}{3} \)  
C) \( \frac{22}{3} \)  
D) \( \frac{25}{3} \)

70) \( y = \frac{1}{x}; \ [0.5, 2] \)

A) 1.69  
B) 1.25  
C) 1.50  
D) 1.39

71) \( y = e^x; \ [1, 2] \)

A) \( e^2 - e \)  
B) \( e^2 + e \)  
C) \( e^2 + e - 1 \)  
D) \( e^2 - e + 1 \)
Solve the problem.

72) Red Plains Roasting has found that the cost, in dollars per pound, of the peanuts it roasts, is

\[ C'(x) = -0.014x + 6.50, \text{ for } x \leq 500, \]

where \( x \) is the number of pounds of peanuts roasted. Find the total cost of roasting 300 pounds of peanuts.

A) $4.40  
B) $1320.00  
C) $2640.00  
D) $2.30

73) Creamy Bugs Yogurt has found that the cost, in dollars per pound, of the yogurt it produces, is

\[ C'(x) = -0.003x + 4.50, \text{ for } x \leq 300, \]

where \( x \) is the number of pounds of yogurt produced. Find the total cost of producing 260 pounds of yogurt.

A) $1068.60  
B) $4.11  
C) $2137.20  
D) $3.72

74) Hatts and Company determines that its marginal cost, in dollars per hat, is given by

\[ C'(x) = -\frac{3}{40}x + 40, \text{ for } x \leq 350. \]

Find the total cost of producing the first 260 hats.

A) $20.50  
B) $30.25  
C) $15,730.00  
D) $7865.00

Evaluate the indefinite integral.

75) \( \int (x - 4)^2 x^2 \, dx \)

A) \( x^5 - 8x^4 + 16x^3 + C \)  
B) \( 4x^3 - 2x^4 + \frac{16}{3}x^2 + C \)  
C) \( \frac{x^5}{5} - 2x^4 + \frac{16}{3}x^3 + C \)  
D) \( \frac{x^5}{4} - \frac{8}{3}x^4 + 8x^3 + C \)

76) \( \int x^5(x^4 + 14x - 11) \, dx \)

A) \( \frac{x^{10}}{10} + 2x^7 - \frac{11x^6}{6} + C \)  
B) \( \frac{x^6}{6}(x^4 + 14x - 11) + x^5\left(\frac{x^5}{5} + 7x^2 - 11x\right) + C \)  
C) \( \frac{x^6}{6}\left(\frac{x^5}{5} + 7x^2 - 11x\right) + C \)  
D) \( \frac{x^{10}}{10} + 7x^2 - 11x + C \)

77) \( \int \frac{x^5 - 5x + 6}{x^2} \, dx \)

A) \( \frac{x^4}{4} + \frac{5}{x^2} - \frac{12}{x^3} + C \)  
B) \( \frac{x^4}{4} - \frac{5x^2}{2} - \frac{6}{x} + C \)  
C) \( \frac{x^4}{4} - 5 \ln |x| - \frac{6}{x} + C \)  
D) \( x^4 - 5 \ln |x| + \frac{6}{x} + C \)
78) \[ \int \frac{t^2 - 4}{t - 2} \, dt \]

A) \( 1 \)  
B) \( \frac{t^2}{2} + C \)  
C) \( t^2 + 2t + C \)  
D) \( \frac{t^2}{2} + 2t + C \)

Evaluate.

79) \[ \int 15x^{-8} \, dx \]

A) \( \frac{15}{7x^9} + C \)  
B) \( -\frac{15}{7}x^{-7} + C \)  
C) \( -120x^{-9} + C \)  
D) \( \frac{105}{x^7} + C \)

80) \[ \int \frac{61}{x} \, dx \]

A) \( 61 \ln x + C \)  
B) \( \frac{61}{2}x^{-2} + C \)  
C) \( \ln \left( \frac{x}{61} \right) + C \)  
D) \( 61x + C \)

81) \[ \int 12x^3 \sqrt{x} \, dx \]

A) \( \frac{24}{7}x^{9/2} + C \)  
B) \( \frac{2}{9}x^{9/2} + C \)  
C) \( \frac{11}{5}x^{9/2} + C \)  
D) \( \frac{8}{3}x^{9/2} + C \)

82) \[ \int (x^{4/3} - 3x^{5/2}) \, dx \]

A) \( \frac{3}{4}x^{7/3} - \frac{3}{7}x^{7/2} + C \)  
B) \( \frac{3}{7}x^{7/3} - \frac{6}{7}x^{7/2} + C \)  
C) \( \frac{3}{7}x^{7/3} - \frac{2}{7}x^{7/2} + C \)  
D) \( \frac{3}{4}x^{7/3} - \frac{4}{7}x^{7/2} + C \)

Provide an appropriate response.

83) Which of the following statements regarding the graph of \( y = e^x \) is false?  
I. The graph lies above the x-axis for all values of \( x \).  
II. The graph is increasing over the entire real number line.  
III. The graph is concave up over the entire real number line.  
IV. The graph has an inflection point at \( x = 0 \).  
A) I  
B) II  
C) III  
D) IV

84) True or false, for the graph of \( y = 2^x \), the slope of the tangent line is the same as the function value at any \( x \).  
A) False  
B) True

85) True or false, for the graph of \( y = e^x \), the slope of the tangent line is the same as the function value at any \( x \).  
A) False  
B) True
86) Which of the following statements regarding the graph of \( y = \log x \) is false?

I. The graph lies below the x-axis for \( 0 < x < 1 \).
II. The graph is increasing over the entire real number line.
III. The graph is concave down over the entire real number line.
IV. The domain is \([0, \infty)\).

A) IV  B) II  C) I  D) III