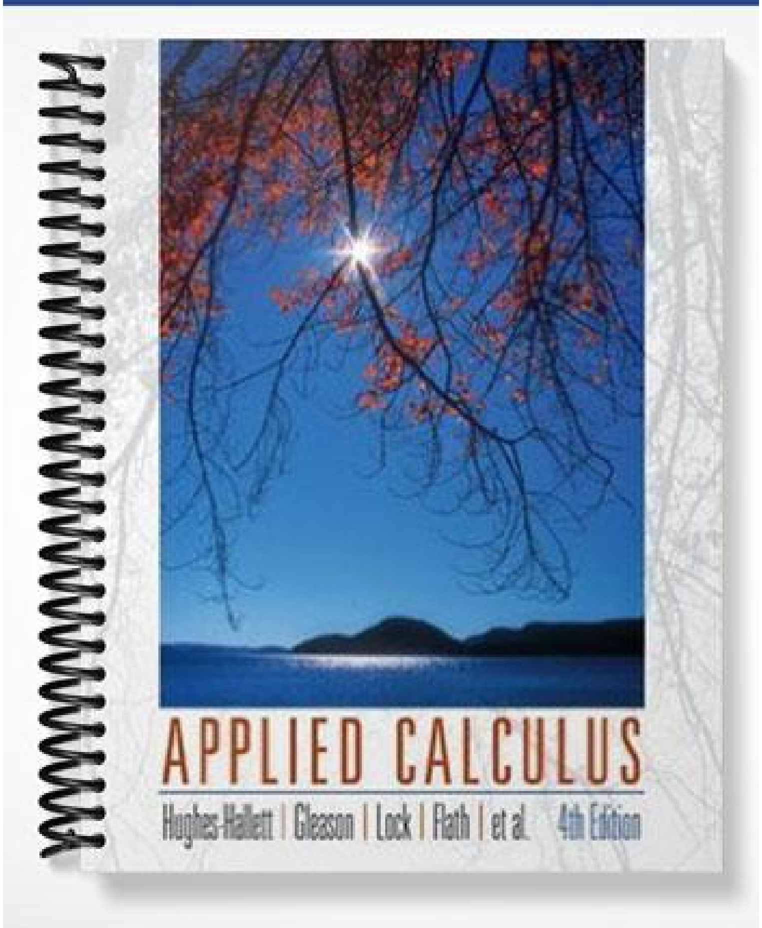
TEST BANK


APPLIED CALCULUS
Hughes-Hallett | Gleason | Lock | Flath | et al.
4th Edition

1. Recently Esther swam a lap in an Olympic swimming pool (the length of the pool is 50 meters, and the length of a lap is 100 meters); her times for various positions *s* (in meters from her starting point) during the lap are given in the following table. Her approximate velocity at time *t*=52 seconds was _____ m/sec. Round to 3 decimal places.

t(sec)	0	6.4	13.2	20.4	27.6	34.8	41.6	48.4	55.6	62.8	69.6
s(m)	0	10	20	30	40	50	40	30	20	10	0

2. Let $f(t) = t^2 + t$. What is the average rate of change in $f(t)$ between *t*=2 and *t*=4?

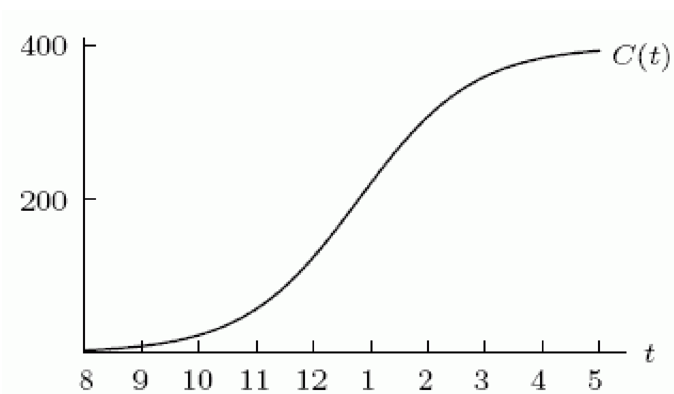
3. An amount of $500 was invested in 1970 and the investment grew as shown in the following table. (Amounts are given for the beginning of the year.) The average rate of increase of the investment between 1975 and 1980 is _____ per year.

Year	1970	1975	1980	1985	1990	1995
Capital	500	966	1856	3578	6876	13,233

4. If $x(V) = V^{1/3}$ is the length of the side of a cube in terms of its volume, then calculate the average rate of change of *x* with respect to *V* over the interval 1<*V*<2. Round to 2 decimal places.

5. Let $x(V) = V^{1/3}$ be the length of the side of a cube in terms of its volume. As *V* decreases, does the rate of change of *x* increase or decrease?

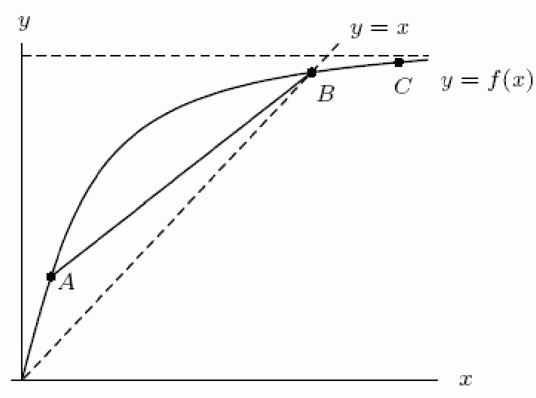
6. The following figure is the graph of $N = C(t)$, the cumulative number of customers served in a certain store during business hours one day, as a function of the hour of the day. About when was the store the busiest?



A) 11am B) 1pm C) 3pm D) 5pm

7. The graph of $y = f(x)$ is shown below. Arrange the following values in order from smallest to largest by placing a "1" by the smallest, a "2" by the next smallest, and so forth.

A. $f'(A)$ B. $f'(B)$ C. $f'(C)$ D. slope AB E. 1
F. 0



8. Estimate $f'(0)$ when $f(x) = 2^{-x}$. Take smaller and smaller intervals until your estimate is accurate to 3 decimal places.

9. Given the following data about the function *f*, estimate $f'(3.3)$.

x	3.0	3.2	3.4	3.6	3.8
$f(x)$	8.2	9.5	10.5	11.0	13.2

10. Given the following data about the function *f*, give the average rate of change of *f* between *x*=3.0 and *x*=3.8. Round to 2 decimal places.

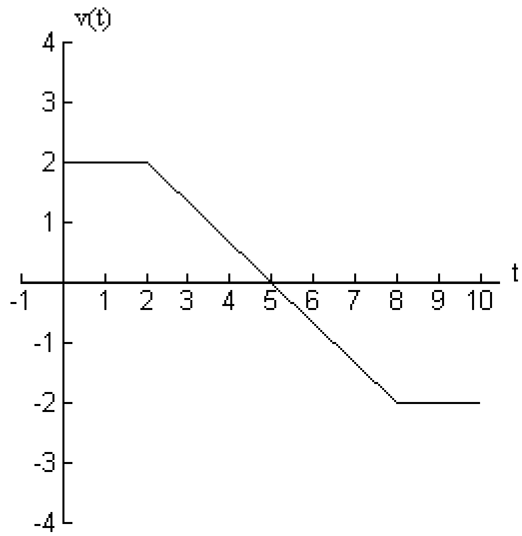
x	3.0	3.2	3.4	3.6	3.8
$f(x)$	8.2	9.5	10.5	11.0	13.2

11. Given the following data about the function *f*, the equation of the tangent line at *x*=3.2 is approximately *y* = _____*x*+_____. Use the nearest right-hand value to make your estimate.

x	3.0	3.2	3.4	3.6	3.8
$f(x)$	8.2	9.5	10.5	11.0	13.2

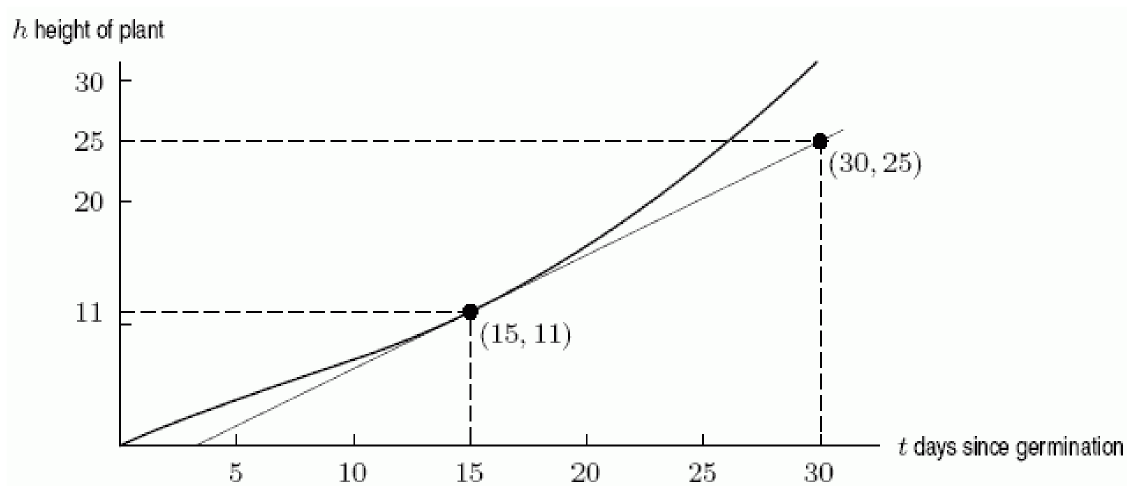
12. A certain function f is decreasing and concave down. In addition, $f'(3) = -2$ and $f(3) = 4$. Which of the following are possible values for $f(2)$? Select all that apply.
A) 4 B) 5 C) 6 D) 7

13. Given the graph below of $y = v(t)$, is $v'(7)$ positive, negative, zero or undefined?

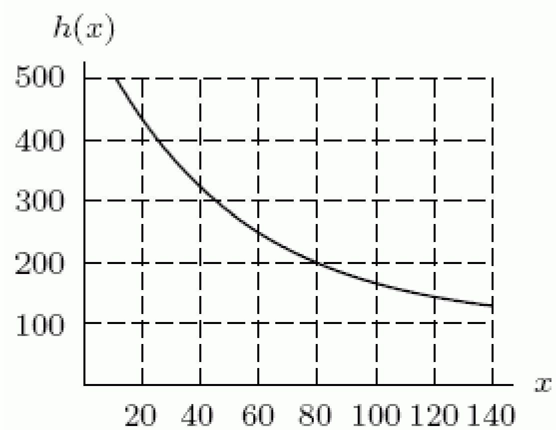


14. A certain function f is decreasing and concave down. In addition, $f'(3) = -2$ and $f(3) = 6$. Which of the following are possible zeroes of f? Select all that apply.
A) 3 B) 5 C) 7 D) 9

15. The growth graph in the following figure shows the height in inches of a bean plant during 30 days. On the 15th day, the plant was growing about _____ inches/day. Round to 2 decimal places.



16. From the following graph, estimate $f'(60)$.



A) –4 B) –3 C) –2 D) –1

17. Using a difference quotient, compute $f'(-1)$ to 2 decimal places for $f(x) = \sin(3x)$.

18. The height of an object in feet above the ground is given in the following table. The average velocity over the interval $0 \le t \le 3$ is _____ feet/sec.

t(sec)	0	1	2	3	4	5	6
y(feet)	10	45	70	85	90	85	70

19. The height of an object in feet above the ground is given in the following table.

t(sec)	0	1	2	3	4	5	6
y(feet)	10	45	70	85	90	85	70

If the height of the object is doubled, the average velocity over any interval
A) doubles also. B) stays the same. C) is cut in half.

20. The graph of $p(t)$ in the figure gives the position of a particle at time t. Arrange the following values in order from smallest to largest by placing a "1" by the smallest, a "2" by the next smallest, and so forth.

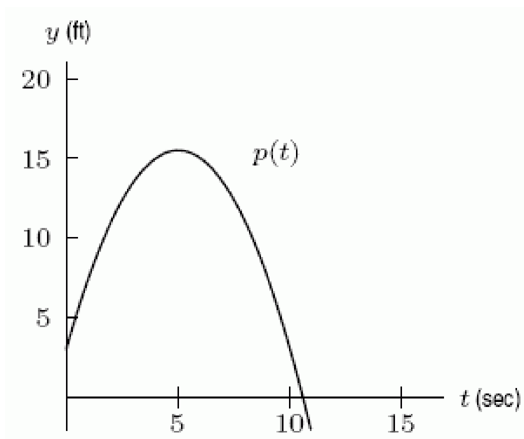
A. average velocity on $1 \le t \le 3$.

B. average velocity on $8 \le t \le 10$.

C. instantaneous velocity at t=1.

D. instantaneous velocity at t=3.

E. instantaneous velocity at t=10.



21. Estimate the value of $f'(2)$ using the following table. Use the nearest right-hand value to make your estimate.

x	0	0.5	1	1.5	2	2.5
$f(x)$	1	1.25	2	3.25	5	7.25

22. Using the following table, tell whether $f'(-3)$ is likely greater than 0, likely less than 0, or might be equal to 0. Type "<",">", or "=".

x	-4	-3	-2	-1	0	1	2	3	4
$f(x)$	7	6	2	1	2	3	2	-1	-5

23. A certain bacterial colony was observed for several hours and the following conditions were reported. Let $N(t)$ be the number of bacteria present after *t* hours.

- There were 1000 bacteria after 5 hours.
- The growth rate was never negative and never exceeded 100 per hour.
- The growth rate was decreasing for the first 5 hours.
- At 7 hours, the growth rate was zero.

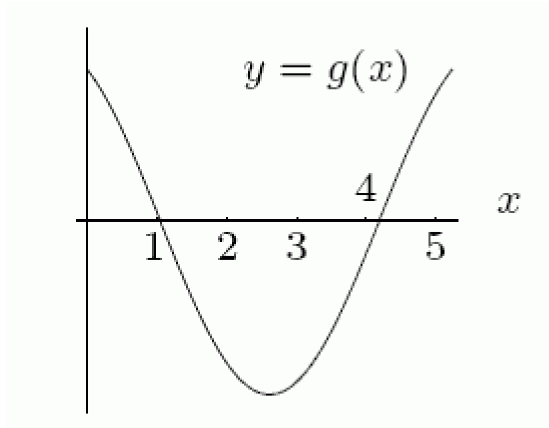
Is it possible that $N(0) = 550$?

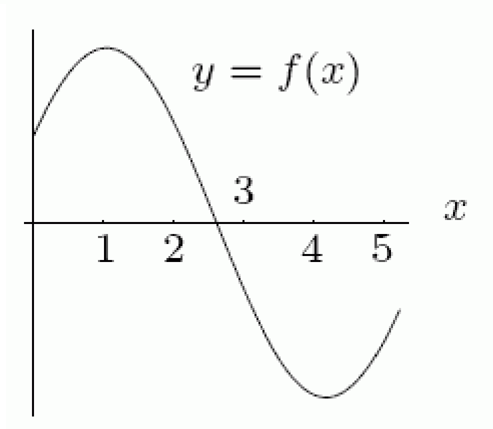
24. A certain bacterial colony was observed for several hours and the following conditions were reported. Let $N(t)$ be the number of bacteria present after *t* hours.

- There were 1000 bacteria after 5 hours.
- The growth rate was never negative and never exceeded 100 per hour.
- The growth rate was decreasing for the first 5 hours.
- At 7 hours, the growth rate was zero.

Is it possible that $N'(5) = 100$?

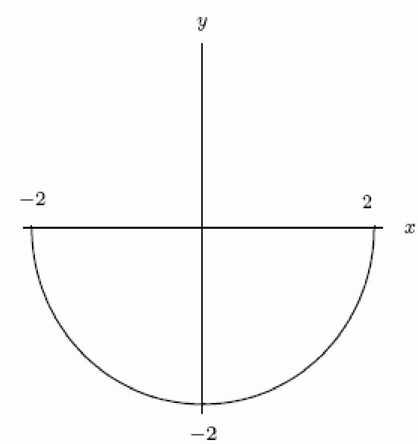
25. Considering the graphs below, could $g(x)$ be the derivative of $f(x)$?

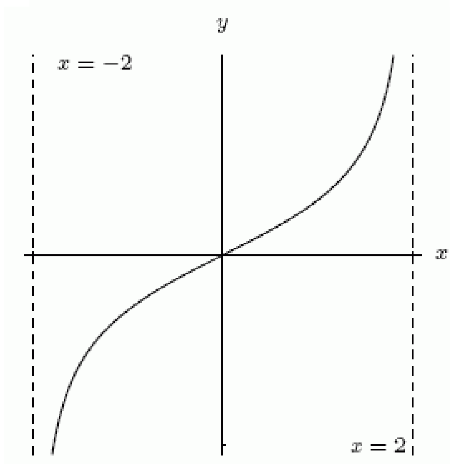




26. Consider the two functions shown below.

A. B.

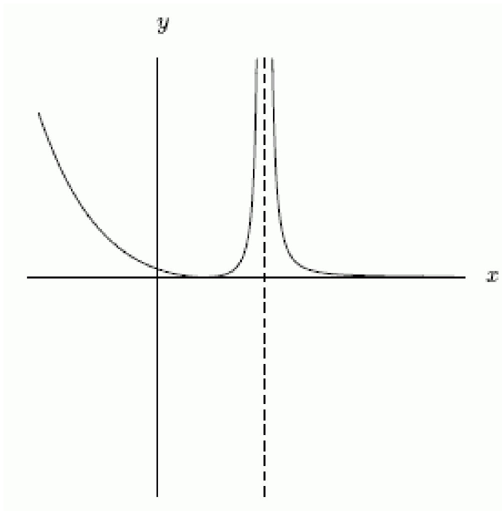


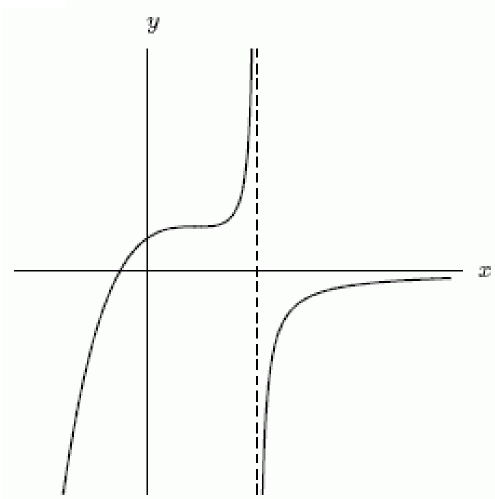


A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.

27. Consider the two functions shown below.

A. B.

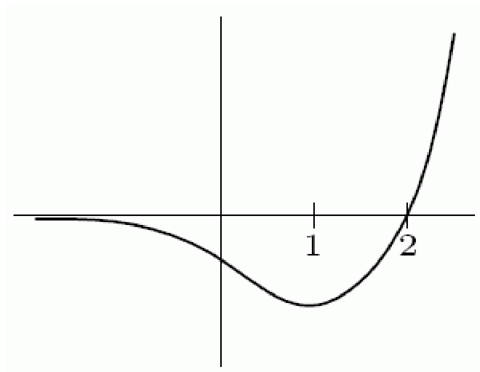


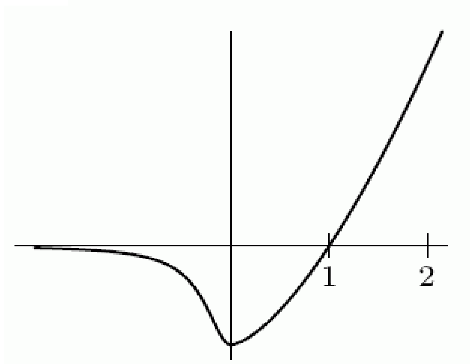


A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.

28. Consider the two functions shown below.

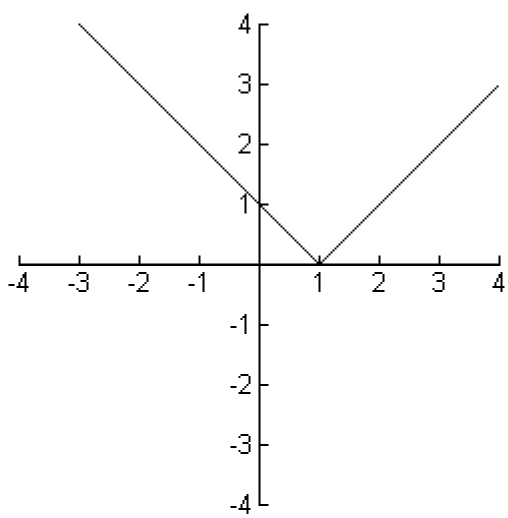
A. B.



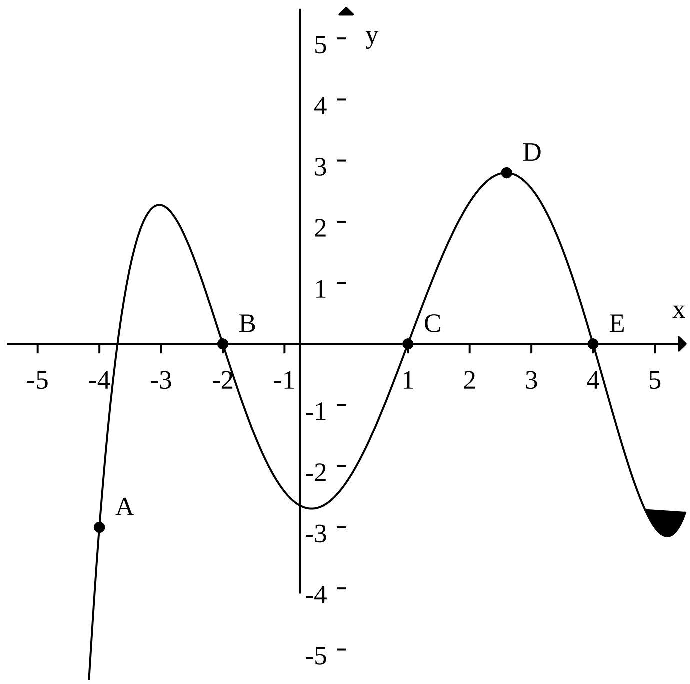


A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.

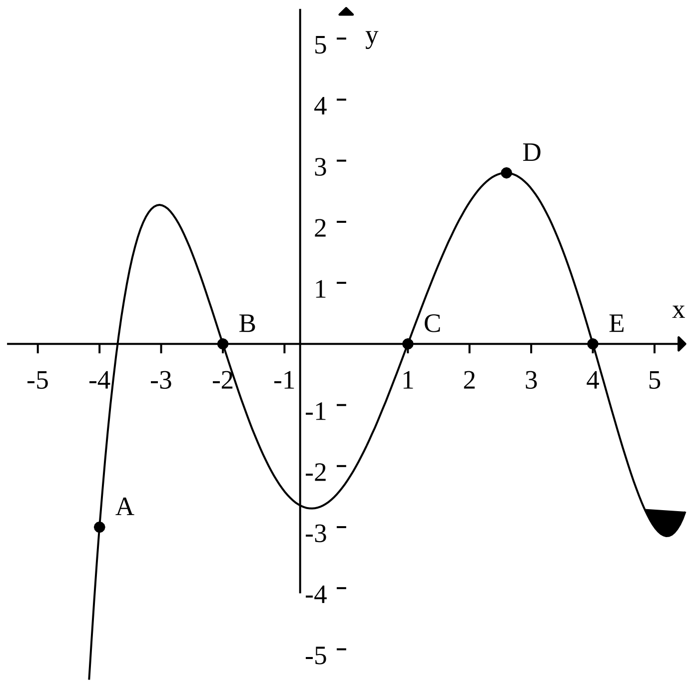
29. The graph below is the graph of $M'(x)$, the *derivative* of $M(x)$. At 4 is the original function $M(x)$ increasing, decreasing, constant or undefined?



30. Using the graph of $f(x)$, at x=A is dy/dx positive ?



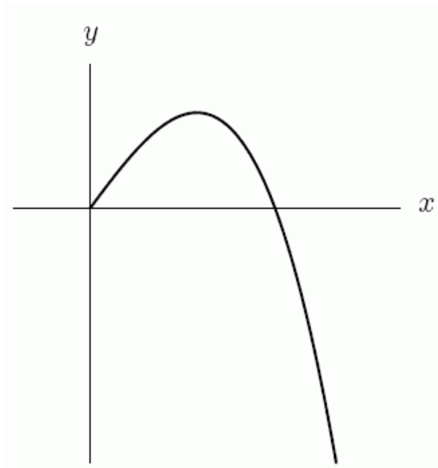
31. Using the graph of $f(x)$, at x=E is dy/dx positive ?



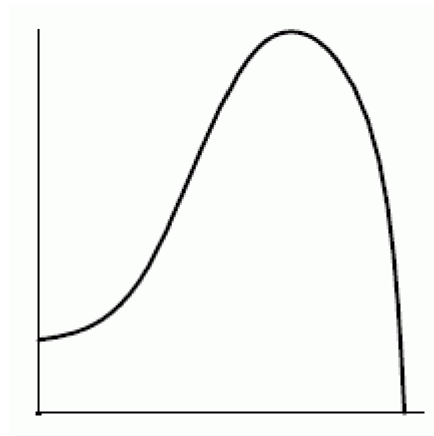
32. The time that a turkey cooks is measured by y minutes for x pounds, and is given by the function $y = f(x)$. What are the units of A) $f'(10)$ and B) $f''(10)$?

33. Consider the two functions shown below.

A.



B.



A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.

34. Let $g(v)$ be the fuel efficiency of a car moving at *v* miles per hour. with efficiency measured in miles per gallon. Suppose $g(55)=25$ and $g'(55)=-0.5$. What would you expect $g(56)$ to be?

35. Suppose $g(t)$ is the height in inches of a person who is *t* years old. Is it reasonable that $g(30)=70$?

36. Let $t(h)$ be the temperature in degrees Celsius at a height *h* (in meters) above the surface of the earth. Which of the following gives the rate of change of temperature with respect to a height at 40 meters above the surface of the earth, in degrees per meter?

A) $t(40)$ B) $t'(40)$ C) *h* such that $t(h)=40$ D) *h* such that $t'(h)=40$

37. Suppose $g(t)$ is the height in inches of a person who is *t* years old. Would you expect $g'(40)$ to be

A) greater than 0 B) less than 0 C) equal to 0

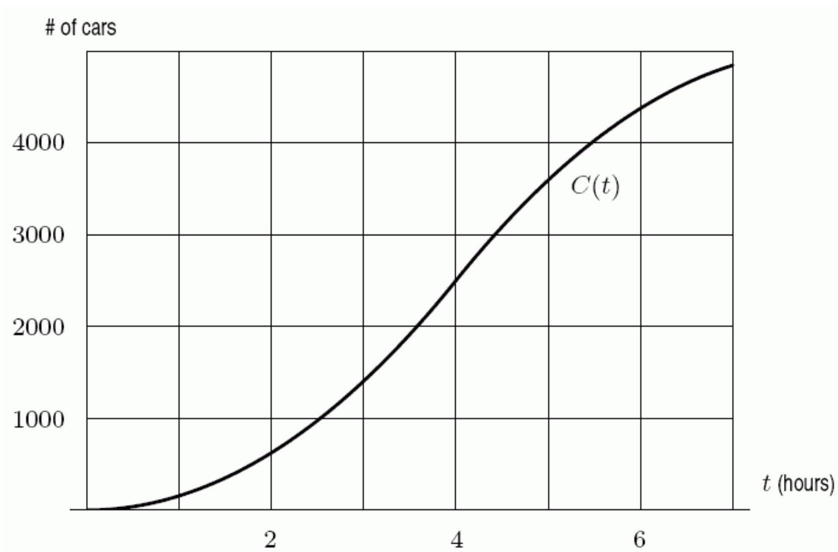
38. Let $f(T)$ be the time, in minutes, that it takes for an oven to heat up to T° F. What are the units of $f'(T)$?

A) degrees per minute B) minutes per degree

39. Let $f(T)$ be the time, in minutes, that it takes for an oven to heat up to T° F. What is the sign of $f'(T)$?
A) positive B) negative

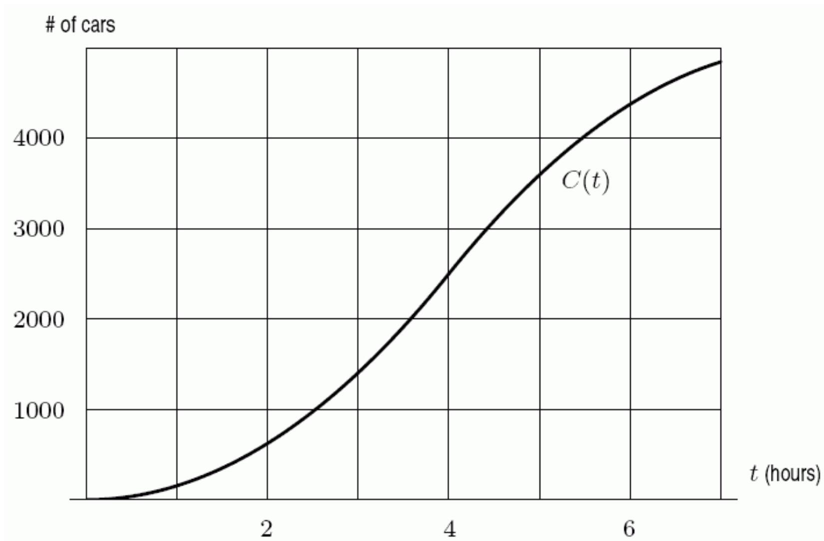
40. Suppose that $f(T)$ is the cost to heat my house, in dollars per day, when the outside temperature is T° Fahrenheit. If $f(23) = 11.59$ and $f'(23) = -0.25$, approximately what is the cost to heat my house when the temperature is $20^{\circ}\mathrm{F}$?

41. To study traffic flow along a major road, the city installs a device at the edge of the road at 4:00 am. The device counts the cars driving past, and records the total periodically. The resulting data is plotted on a graph, with time (in hours) on the horizontal axis and the number of cars on the vertical axis. The graph is shown below. It is a graph of the function $C(t)$ = Total number of cars that have passed by after *t* hours. When is the traffic flow the greatest?



A) At *t*=6 hours. B) At *t*=3 hours. C) At *t*=4 hours. D) At *t*=5 hours.

42. To study traffic flow along a major road, the city installs a device at the edge of the road at 4:00 am. The device counts the cars driving past, and records the total periodically. The resulting data is plotted on a graph, with time (in hours) on the horizontal axis and the number of cars on the vertical axis. The graph is shown below. It is a graph of the function $C(t)$ = Total number of cars that have passed by after *t* hours. Estimate $C'(3)$.



A) 1000 B) 1300 C) 1600 D) 1900

43. Let $L(r)$ be the amount of lumber, in board-feet, produced from a tree of radius *r* (measured in inches). Which of the following gives the rate of change in the amount of lumber, in board-feet per inch, with respect to the radius when the radius is 19 inches?

A) $L(19)$ B) $L'(19)$ C) *r* such that $L(r)=19$ D) *r* such that $L'(r)=19$

44. Every day the Undergraduate Office of Admissions receives inquiries from eager high school students (e.g. "Please send me an application",etc.) They keep a running count of the number of inquiries received each day, along with the total number received until that point. Below is a table of *weekly* figures from about the end of August to about the end of October of a recent year. One of these columns can be interpreted as a rate of change. Which one is it?

Week of	Inquiries That Week	Total for Year
8/28–9/01	1085	11,928
9/04–9/08	1193	13,121
9/11–9/15	1312	14,433
9/18–9/22	1443	15,876
9/25–9/29	1588	17,464
10/02–10/06	1746	19,210
10/09–10/13	1921	21,131
10/16–10/20	2113	23,244
10/23–10/27	2325	25,569

A) "Week of" B) "Inquiries That Week" C) "Total for Year"

45. The cost of extracting T tons of ore from a copper mine is $f(T)$ dollars. What are the units for $f'(T)$?
A) dollars/ton B) tons/dollar

46. The cost of extracting T tons of ore from a copper mine is $f(T)$ dollars. Would you expect $f'(T)$ to be positive or negative?
A) positive B) negative

47. The following table shows the number of oranges sold in one month, $f(p)$, against the price per bag, p (in cents). Find an approximation for $f'(900)$. Use the nearest right-hand value to make your estimate.

Price p (in cents)	750	800	850	900	950
Number of bags, $f(p)$	50,000	48,000	44,000	37,000	29,000

48. The following table gives the wind chill factor ($^\circ$F) as a function of the wind speed (miles/hour) when the air temperature is 20 $^\circ$F. What is the derivative of wind chill with respect to wind speed when the air temperature is 20 $^\circ$F and the wind speed is 20 miles per hour? Use the nearest right-hand value to make your estimate.

Wind speed (mph)	5	10	15	20	25
Wind chill factor ($^\circ$F)	16	3	-5	-10	-15

49. Let $t(h)$ be the temperature in degrees Celsius at a height *h* (in meters) above the surface of the earth. Which of the following gives the temperature in degrees Celsius at a height of 500 meters?
A) $t(500)$ B) $t'(500)$ C) *h* such that $t(h) = 500$ D) *h* such that $t'(h) = 500$

50. Let $t(h)$ be the temperature in degrees Celsius at a height *h* (in meters) above the surface of the earth. Which of the following gives the height, in meters, at which the rate of change of temperature with respect to height is 15 degrees per meter?
A) $t(15)$ B) $t'(15)$ C) *h* such that $t(h) = 15$ D) *h* such that $t'(h) = 15$

51. Let $L(r)$ be the amount of lumber, in board-feet, produced from a tree of radius *r* (measured in inches). Which of the following gives the number of board-feet obtained from a tree of radius 8 inches?
A) $L(8)$ B) $L'(8)$ C) *r* such that $L(r) = 8$ D) *r* such that $L'(r) = 8$

52. Let $L(r)$ be the amount of lumber, in board-feet, produced from a tree of radius *r* (measured in inches). Which of the following gives the radius (in inches) at which the rate of change is 250 board-feet of lumber per inch?
A) $L(250)$ C) *r* such that $L'(r) = 250$
B) $L'(250)$ D) *r* such that $L(r) = 250$

53. Let $C(t)$ represent the dollar amount charged per hour by a computer consultant to a client when they sign a contract *t* hours of work. The consultant gives a discount to the client if the contract is increased by 10 hours. Estimate the amount charged per hour when the client orders 90 hours of work.

54. Let $C(t)$ represent the dollar amount charged per hour by a computer consultant to a client when they sign a contract *t* hours of work. The consultant gives a discount to the client if the contract is increased by 10 hours. Interpret the following statements.

A) $C(10) = 70$.

B) $C'(10) = \frac{-5}{10}$.

55. The noise level, *N*, in decibels, of a rock concert is given by $N = f(d)$, where *d* is the distance in meters from the concert speakers. Which of the following gives the rate of change, in decibels per meter, of noise 800 meters away from the speakers?

A) $f(800)$
B) $f'(800)$
C) d such that $f(d) = 800$
D) d such that $f'(d) = 800$

56. The noise level, *N*, in decibels, of a rock concert is given by $N = f(d)$, where *d* is the distance in meters from the concert speakers. Which of the following gives the distance, in meters, away from the speakers at which the noise is 80 decibels?

A) $f(80)$ B) $f'(80)$ C) d such that $f(d) = 80$ D) d such that $f'(d) = 80$

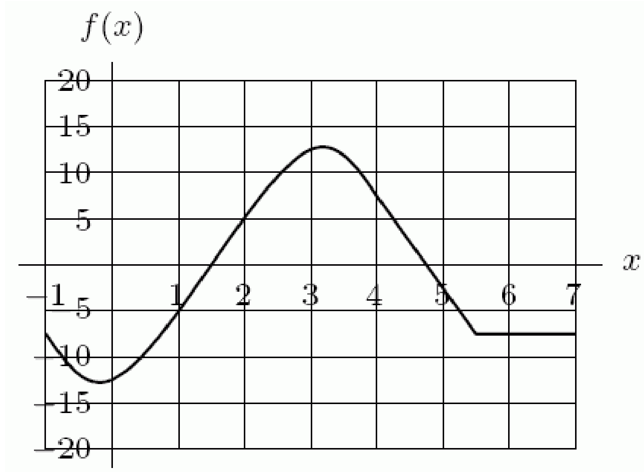
57. The population of a certain town is given by the function $P(t)$ where *t* is the number of years since the town was incorporated. If $P'(t)$ is constant for *t*>185, what will $P(200)$ be if $P(185) = 26,000$ and $P'(185) = 275$?

58. The following table gives the wind chill factor ($^\circ$F) as a function of the wind speed (miles/hour) when the air temperature is 20 $^\circ$F. What are the units for the derivative of wind chill with respect to wind speed when the air temperature is 20 $^\circ$F?

Wind speed (mph)	5	10	15	20	25
Wind chill factor ($^\circ$F)	16	3	-5	-10	-15

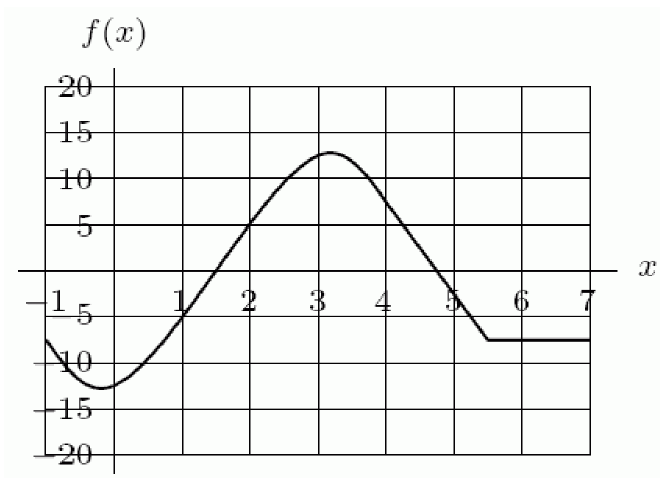
A) mph/$^\circ$F B) $^\circ$F/mph

59. The graph of $f(x)$ is shown in the following figure. Give an estimate for $f'(1)$



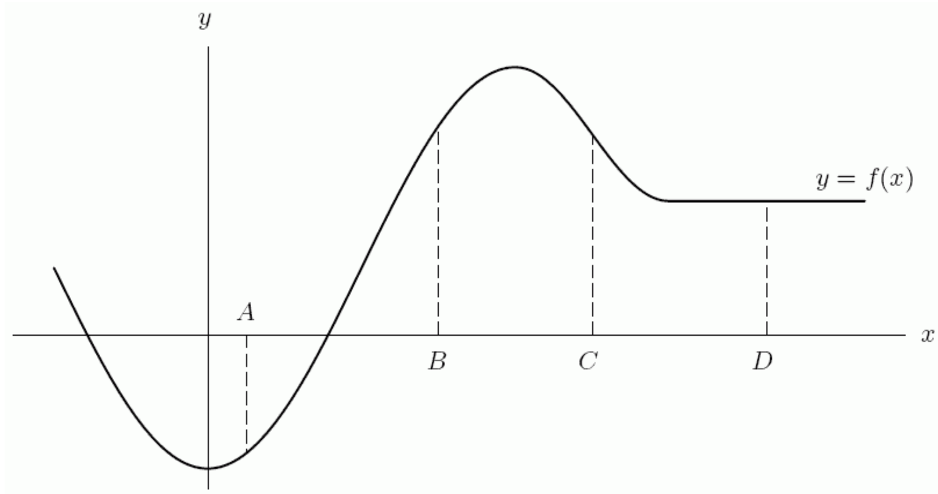
A) 10 B) –10 C) 20 D) –20

60. The graph of $f(x)$ is shown in the following figure. Is $f''(2.5)$ positive, negative, or zero?

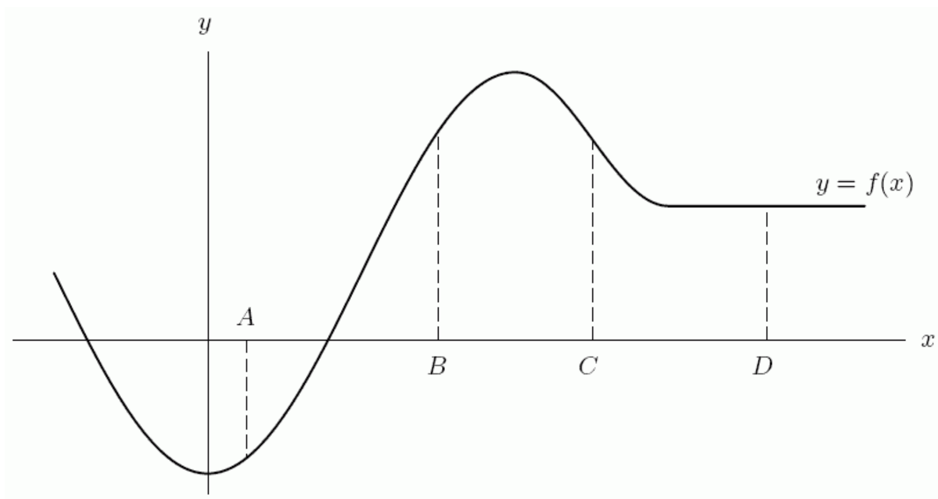


A) negative B) zero C) positive

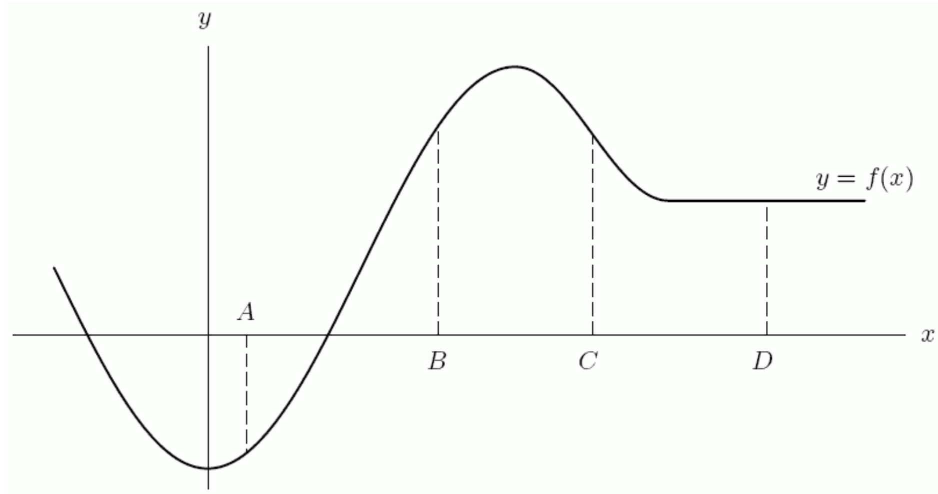
61. Suppose the graph of f is in the figure below. Is $f(D)$ positive, negative, or zero?



62. Suppose the graph of f is in the figure below. Is $f'(A)$ positive, negative, or zero?



63. Suppose the graph of f is in the figure below. Is $f''(A)$ positive, negative, or zero?



64. A function f satisfies the following conditions: $f(2)=10$, $f(8)=7$, $f'(2)<0$, $f'(8)>0$, and $f''(x)>0$ for $2 \le x \le 8$. Which of the following are possible values for $f(5)$? Select all that apply.
A) 4 B) 9 C) 12

65. Suppose a function is given by the following table of values. Estimate the instantaneous rate of change of f at x=1.7, and use this estimate to find the equation for the tangent line to f at x=1.7. The line is y = _____x+_____. Use the nearest right-hand value to make your estimate.

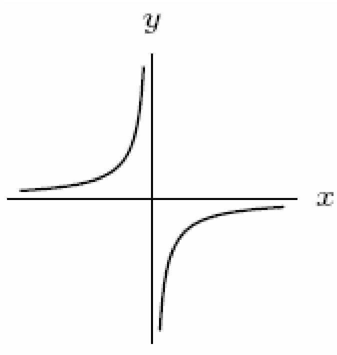
x	1.1	1.3	1.5	1.7	1.9	2.1
$f(x)$	12	15	21	23	24	25

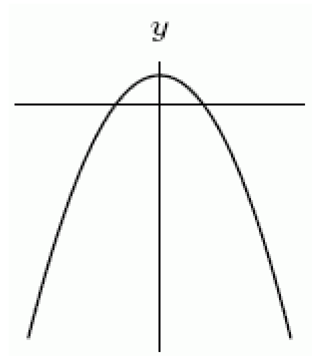
66. Suppose a function is given by the following table of values. Is f'' most likely positive or negative at x=1.9?

x	1.1	1.3	1.5	1.7	1.9	2.1
$f(x)$	12	15	21	23	24	25

A) positive B) negative

67. Could the function on the right be the second derivative of the function on the left?





68. The cost of mining a ton of coal is rising faster every year. Suppose $C(t)$ is the cost of mining a ton of coal at time *t*. Which of the following must be positive? Select all that apply.

A) $C(t)$ B) $C'(t)$ C) $C''(t)$

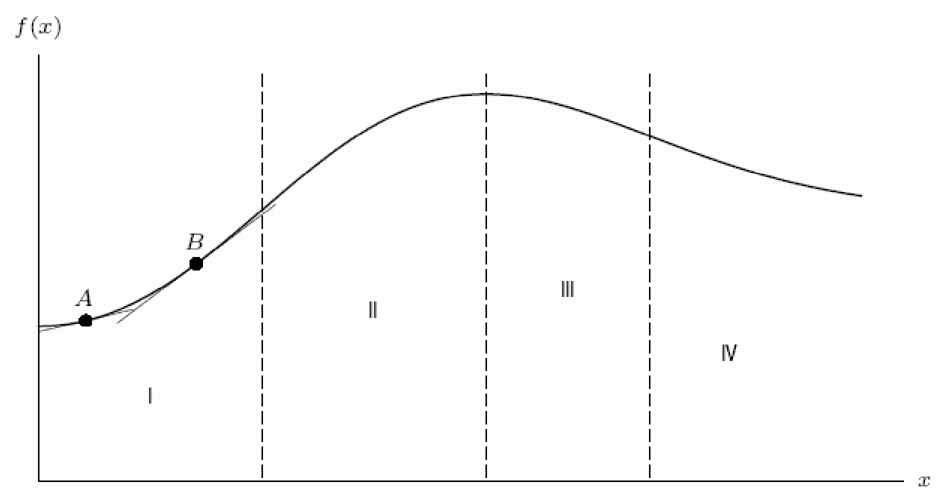
69. The cost of mining a ton of coal is rising faster every year. Suppose $C(t)$ is the cost of mining a ton of coal at time *t*. Which of the following must be increasing? Select all that apply.

A) $C(t)$ B) $C'(t)$ C) $C''(t)$

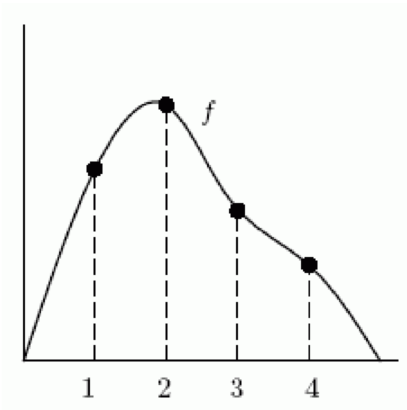
70. The cost of mining a ton of coal is rising faster every year. Suppose $C(t)$ is the cost of mining a ton of coal at time *t*. Which of the following must be concave up? Select all that apply.

A) $C(t)$ B) $C'(t)$ C) $C''(t)$

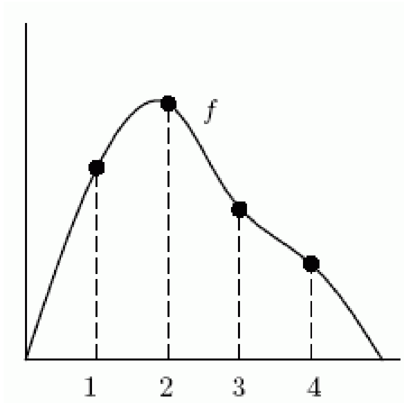
71. Consider the following graph. In region II, $f'(x)$ is ________ (positive/negative) and $f''(x)$ is ________ (positive/negative).



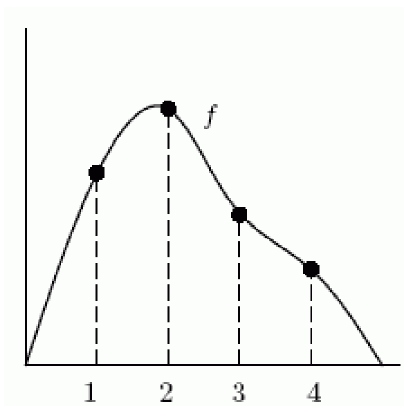
72. Consider the function f sketched in the following figure. Do you expect $\dfrac{f(4)-f(2)}{2}$ to be positive, negative, or zero?



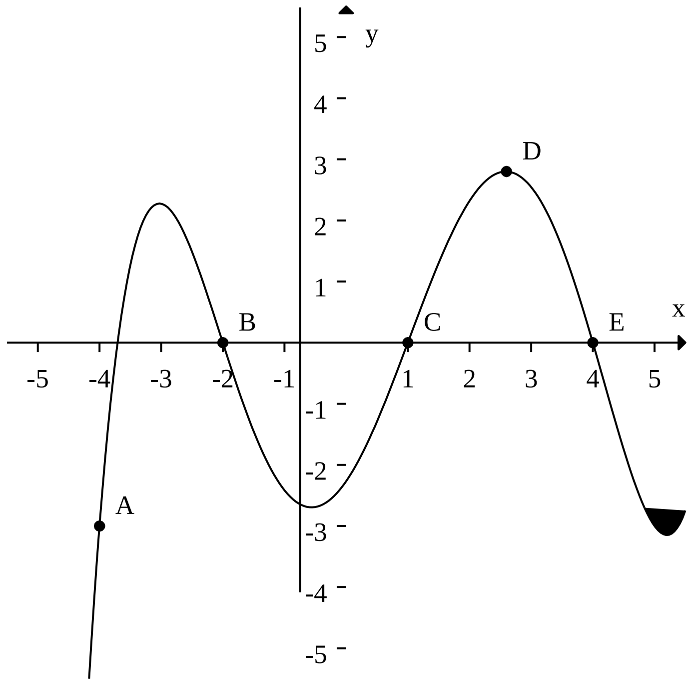
73. Consider the function *f* sketched in the following figure. Do you expect $f'(1)$ to be positive, negative, or zero?



74. Consider the function *f* sketched in the following figure. Do you expect $f''(3)$ to be positive, negative, or zero?



75. Using the graph of $f(x)$, at x=D is $\frac{d^2y}{dx^2}$ positive, negative or zero?

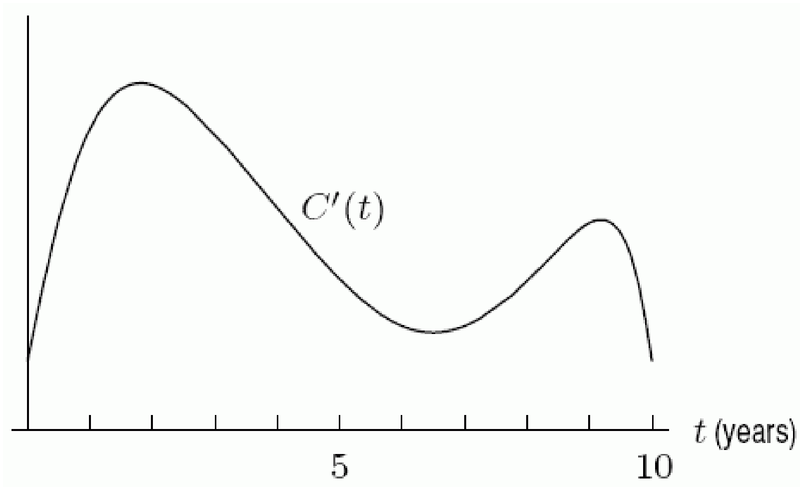


76. Write the Leibniz notation for the first and second derivatives of the given function and include units.
"The amount saved, A, in thousands of dollars, is a function of time x, in seconds"

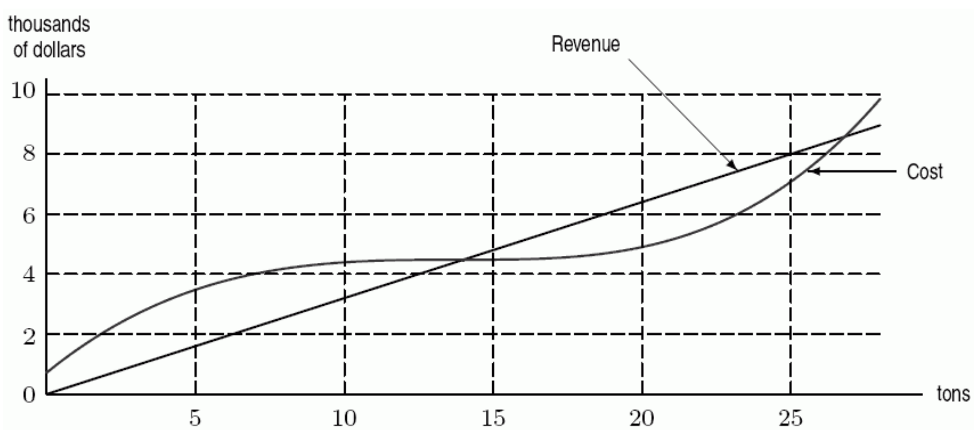
77. Let $S(t)$ represent the number of students enrolled in school in the year t. If the number of students enrolling is increasing faster and faster, then ds/dt _____0 and d^2s/dt^2 _____0. (Enter "<",">", or "=")

78. A driver obeys the speed limit as she travels past different towns in the order *A*, *B*, *C*. In town *A*, the speed limit is 65 mph. In town *B*, the speed limit is 60 mph, and in town *C* the speed limit is 55 mph. It always takes her two minutes to reach the new speed limit when she passes by a new town. If $S(t)$ represents the driver's position at time t, then is $S''(t)$ for the first two minutes she is passing town *B* positive or negative?

79. A company graphs $C'(t)$, the derivative of the number of pints of ice cream sold over the past ten years. Out of t=1,2,4,8, and 10, in what year was $C(t)$ greatest?

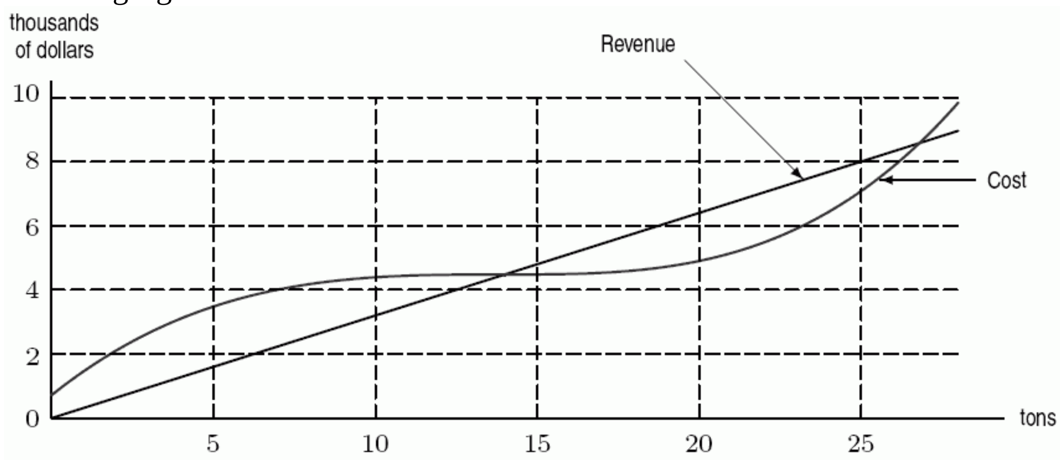


80. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. How much is the revenue from the sale of 10 tons?



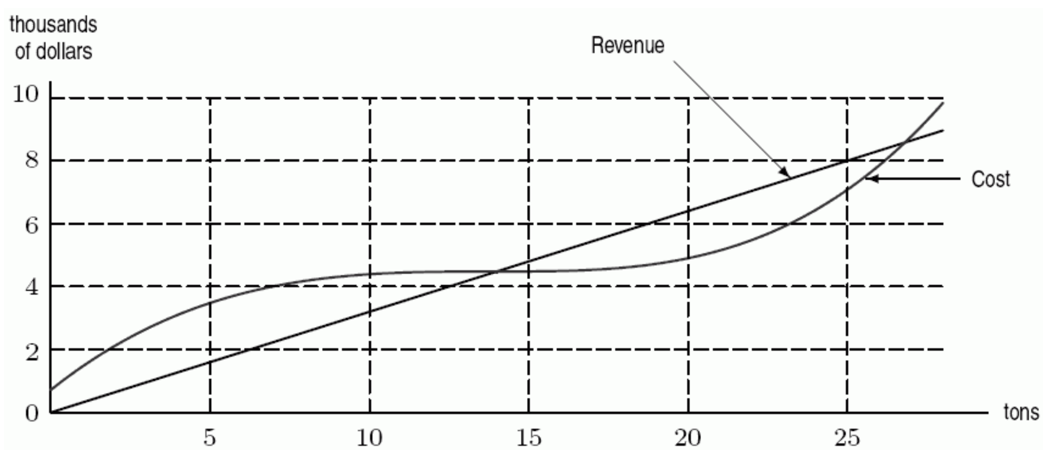
A) $3,200 B) $4,500 C) $3.20 D) $4.50

81. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. When does Revenue=Cost?



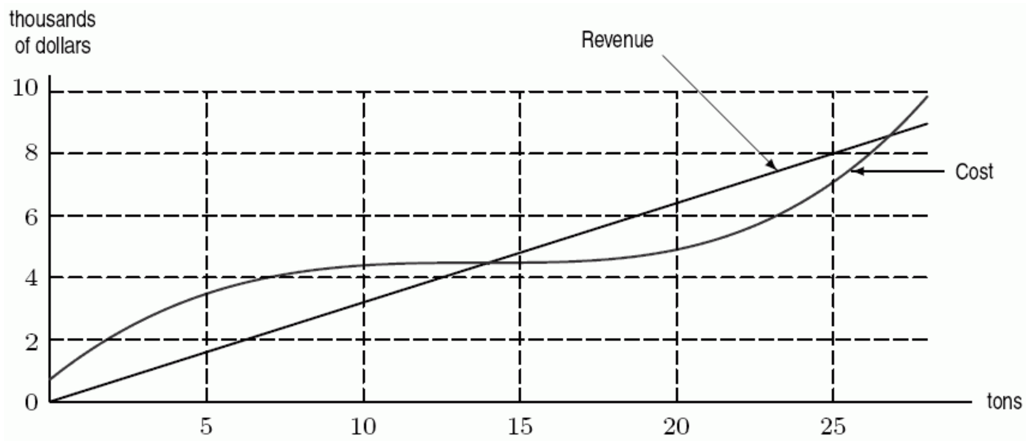
A) 14 tons B) 7 tons C) 22 tons D) 27 tons

82. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. Marginal revenue at 20 tons is about how much?



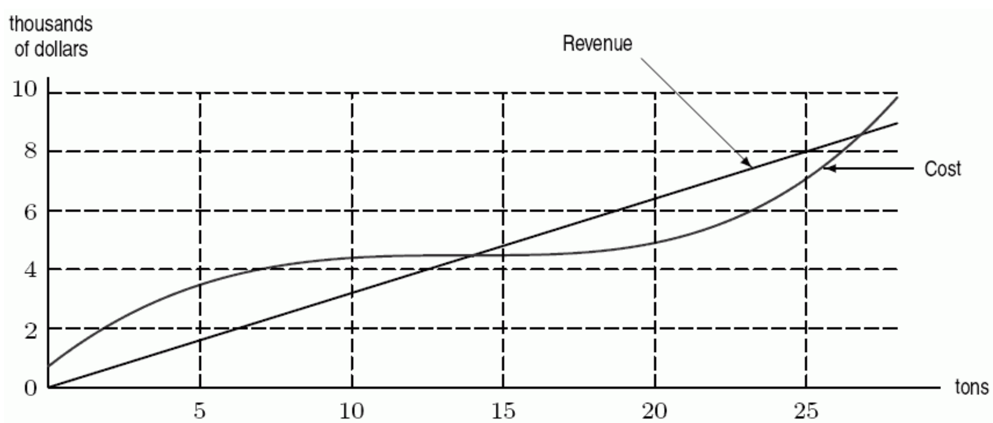
A) $100/ton B) $320/ton C) $5,200/ton D) $4,500/ton

83. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. What is the current sale price?



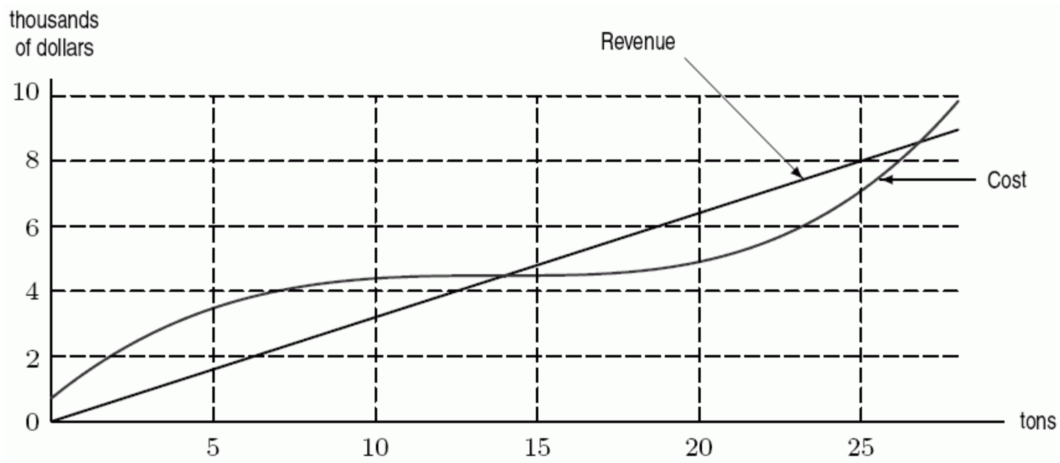
A) \$4,300/ton B) \$8,300/ton C) \$320/ton D) \$500/ton

84. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. Should the company increase production beyond 20 tons?



A) yes B) no

85. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. To maximize profit, how many tons should the company produce?



A) 7 B) 14 C) 25 D) 22

86. To produce 250 items the total cost is \$4600 and the marginal cost is \$15. Estimate the cost of producing 500 items.

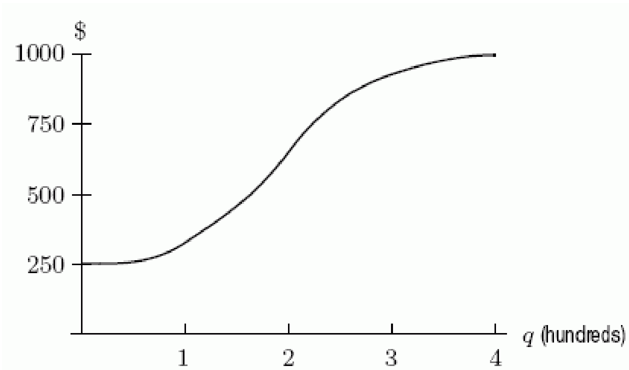
87. To produce 250 items the total cost is \$4800 and the marginal cost is \$12. Which estimate is more likely to be accurate, one for producing 251 items, or one for producing 500 items?

88. The world's only manufacturer of left-handed widgets has determined that if q left-handed widgets are manufactured and sold per year at price p, then the cost function is $C = 8000 + 50q$, and the manufacturer's revenue function is $R = pq$. The manufacturer also knows that the demand function for left-handed widgets is $q = 2000 - 25p$.

A. Write the profit function π in terms of price p.

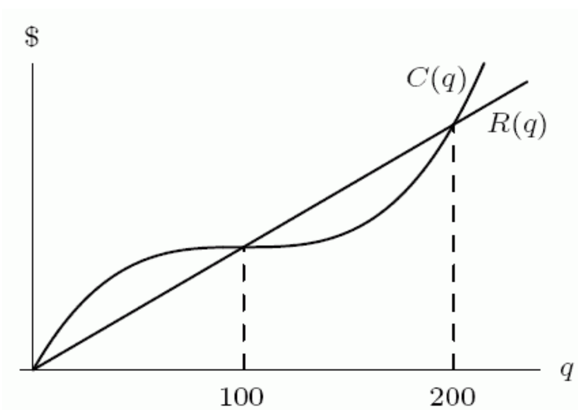
B. Sketch the profit function to determine what price yields the largest profit. What is that price?

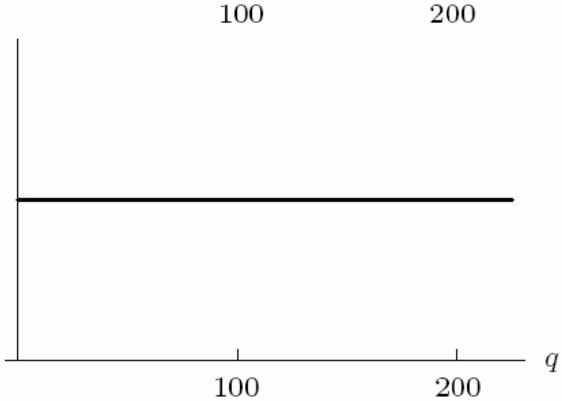
89. The graph of a cost function is given in the following figure. Which item costs the most to produce?



A) The 300th item B) The 100th item C) The 200th item

90. Cost and revenue functions are graphed in the first figure. What does the second figure show?





A) Marginal revenue B) Total profit C) Marginal cost

91. Given the following table, find $\pi(4)$.

q	0	1	2	3	4	5	6	7
$R(q)$	0	3	6	9	12	15	18	21
$C(q)$	3	5	7	8	9	11	14	18

92. Given the following table, find *MR*(6).

q	0	1	2	3	4	5	6	7
$R(q)$	0	3	6	9	12	15	18	21
$C(q)$	3	5	7	8	9	11	14	18

93. The following table gives the cost and revenue, in dollars, for different production levels, q. What is the selling price of the product?

q (units)	0	1000	2000	3000	4000	5000
$R(q)$ (dollars)	0	4000	8000	12,000	16,000	20,000
$C(q)$ (dollars)	1200	5000	8000	10,000	15,000	24,000

94. The following table gives the cost and revenue, in dollars, for different production levels, q. For what value of q is profit maximized?

q (units)	0	1000	2000	3000	4000	5000
$R(q)$ (dollars)	0	3000	6000	9000	12,000	15,000
$C(q)$ (dollars)	1800	4000	6000	7000	11,000	19,000

95. A newspaper headline recently read , " Taxes are increasing at an increasing rate". This says that the second derivative is positive.

96. Your friend Herman operates a neighborhood lemonade stand. He asks you to be his financial advisor and wants to know how much lemonade he can make with the \$3.44 he happens to have on hand. The only information he can give you is that once last month he spent \$2 and made 19 glasses of lemonade, and another time he spent \$5 and made 83 glasses of lemonade. Create a linear cost function, $C(q)$, giving the cost in dollars of making q glasses of lemonade. How many full cups of lemonade can Herman make with this model?

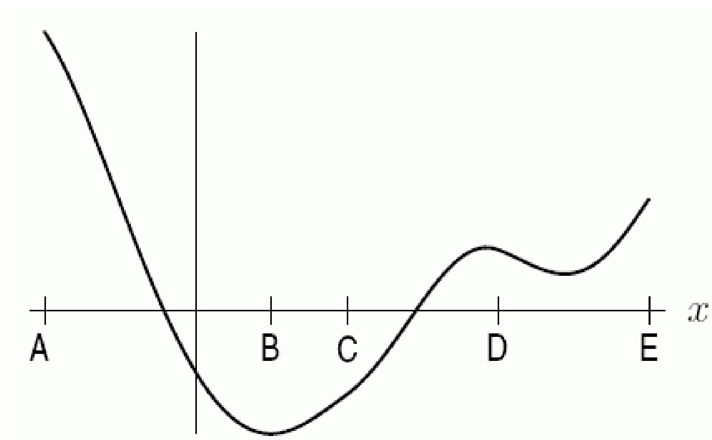
97. Your friend Herman operates a neighborhood lemonade stand. . Last month he spent \$2 and made 19 glasses of lemonade, and another time he spent \$5 and made 83 glasses of lemonade. You decide to use this data to create a linear cost function, $C(q)$, giving the cost in dollars of making q glasses of lemonade. If lemonade sells for \$0.10 per glass, how many glasses must he sell to break even?

98. Your friend Herman operates a neighborhood lemonade stand. He asks you to be his financial advisor and wants to know how much lemonade he can make with the $3.48 he happens to have on hand. The only information he can give you is that once last month he spent $2 and made 19 glasses of lemonade, and another time he spent $5 and made 83 glasses of lemonade. You decide to use this data to create an exponential cost function, $C(q)$, giving the cost in dollars of making q glasses of lemonade. How many full cups of lemonade can Herman make with this model?

99. At a production level of 2000 for a product, marginal revenue is $3.75 per unit and marginal cost is $4.00 per unit. Do you expect maximum profit to occur at a production level above or below 2000?
A) below B) above

100. The graph of $f(x)$ is shown in the following figure. Arrange the following values in order from smallest to largest by placing a "1" by the smallest, a "2" by the next smallest, and so forth.

A. $f'(A)$ B. $f'(B)$ C. $f'(C)$ D. $f'(D)$
E. $f'(E)$



101. A table of values is given for $f(x)$.

A. Is $f'(x)$ positive or negative?

B. Is $f''(x)$ positive or negative?

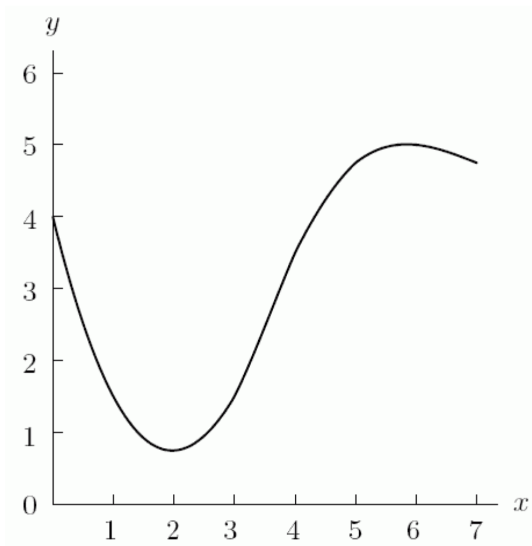
C. Approximate $f'(3.5)$ by averaging the approximations from either side.

x	3	3.5	4	4.5	5	5.5	6
$f(x)$	17	27	34	38	41	43	44

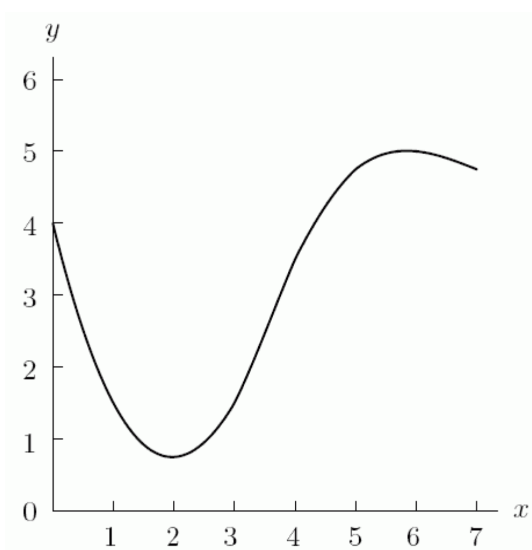
102. The function $y = f(x)$ is graphed below.

A. Is $f'(5)$ positive, negative, or zero?

B. Is $f''(5)$ positive, negative, or zero?

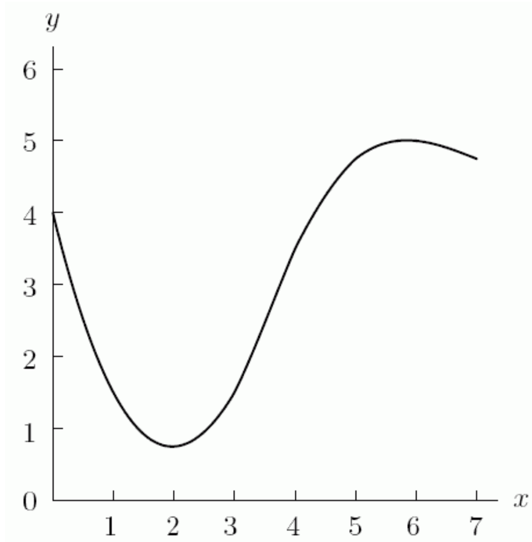


103. The function $y = f(x)$ is graphed below. Which is larger, $f'(5)$ or $f'(4)$?



A) $f'(5)$ B) $f'(4)$

104. The function $y = f(x)$ is graphed below. Which is larger, $f''(1)$ or $f''(4)$?



A) $f''(1)$ B) $f''(4)$

105. The following table gives the number of passenger cars, in millions, in the United States, *C*, as a function of years, *t*. We have $C = f(t)$. Is $f''(t)$ positive or negative?

t (year)	1940	1950	1960	1970	1980
C (# of cars, in millions)	27.5	40.3	61.7	89.3	121.6

106. The following table gives the number of passenger cars, in millions, in the United States, *C*, as a function of years, *t*. We have $C = f(t)$. Estimate $f'(1970)$. Use the nearest right-hand value to make your estimate.

t (year)	1940	1950	1960	1970	1980
C (# of cars, in millions)	27.5	40.3	61.7	89.3	121.6

A) 3.23 million cars/year
B) 89.3 million cars/year
C) 91.65 million cars/year
D) 6.41 million cars/year

107. Given the following data about the function, *f*, use estimates of $f'(3.75)$ and $f'(4.25)$ to estimate $f''(4)$. Use the nearest right-hand value to make your estimate.

x	3	3.5	4	4.5	5	5.5	6
$f(x)$	10	8	7	4	2	0	-1

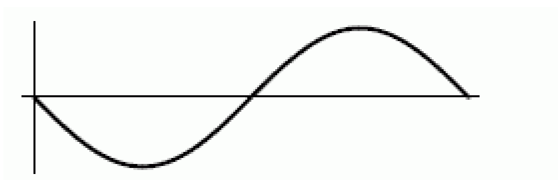
108. Given the following data about the function, *f*, use an approximation of the tangent line at *x*=4.5 to estimate $f(4.75)$.

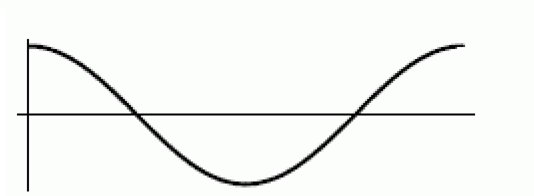
x	3	3.5	4	4.5	5	5.5	6
$f(x)$	10	8	7	4	2	0	-1

109. There is a population of $P(t)$ thousand bacteria in a culture at time *t* hours after the beginning of an experiment. You know that $P(10)=15$, $P'(10)=0.4$, and $P''(10)=0.008$. Using these values, make a prediction for $P(10.5)$.
A) 15.2 B) 15.4 C) 15.6 D) 15.8

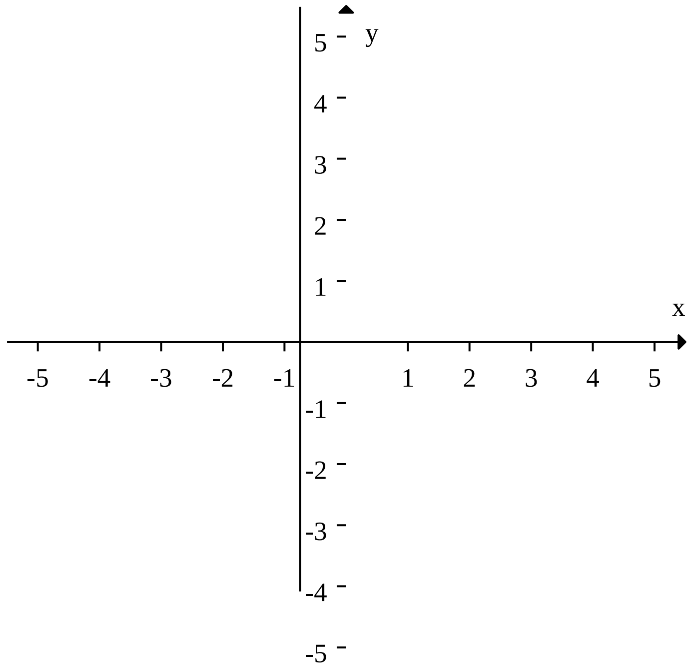
110. There is a population of $P(t)$ thousand bacteria in a culture at time *t* hours after the beginning of an experiment. You know that $P(10)=15$, $P'(10)=0.5$, and $P''(10)=0.008$. Using these values, make a prediction for $P'(10.5)$
A) 0.502 B) 0.504 C) 0.506 D) 0.508

111. The first figure shows the graph of the derivative of a function. Could the second figure be the original function?

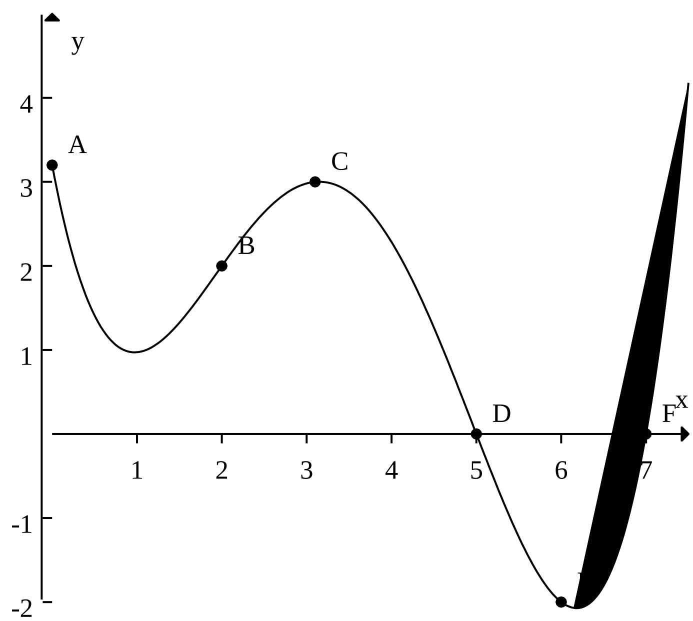




112. Sketch a graph with the following conditions: $f'(x) > 0$ and $f''(x) < 0$.



113. Which point has a slope of 3 ?



114. In 2007, Apple's iTunes music store sold 2 billion songs. The number of iTunes songs purchased (in millions) is shown on the following chart, $S(t)$, where time is measured in days since Apple iTunes sold 1 million songs (March 15, 2003).

Time (in days)	0	100	177	275	366	485	642	856
Songs Purchased (in millions)	1	5	10	25	50	100	200	500

A) Estimate $S'(1396)$ with the appropriate units.
B) Use $S'(1396)$ to estimate $S(1600)$ to 2 decimal places.

115. There is a function used by statisticians, called the error function, which is written $y=\text{erf}(x)$. Suppose you have a statistical calculator, which has a button for this function. Playing with your calculator, you discover the following:

x	erf(x)
1	0.29793972
0.1	0.03976165
0.01	0.00398929
0	0

Using this information alone, give an estimate for erf '(0), accurate to 2 decimal places.

116. Estimate the value of $f'(x)$ for the function $f(x)=13^x$.
A) $2.565x(13)^{x-1}$ B) $x(13)^{x-1}$ C) $13(13)^x$ D) $2.565(13)^x$

117. Assume that f and g are differentiable functions defined on all of the real line. It is possible that $f>0$ everywhere, $f'>0$ everywhere, and $f''<0$ everywhere.

118. Assume that f and g are differentiable functions defined on all of the real line. f can satisfy: $f''>0$ everywhere, $f'<0$ everywhere, and $f>0$ everywhere.

119. Assume that f and g are differentiable functions defined on all of the real line. f and g can satisfy: $f'(x)>g'(x)$ for all x and $f(x)<g(x)$ for all x.

120. Assume that f and g are differentiable functions defined on all of the real line. If $f'(x)=g'(x)$ for all x and if $f(x_0)=g(x_0)$ for some x_0, then $f(x)=g(x)$ for all x.

121. Assume that f and g are differentiable functions defined on all of the real line. If $f''<0$ everywhere and $f'<0$ everywhere then $\lim_{x\to+\infty} f(x)=-\infty$.

122. Assume that f and g are differentiable functions defined on all of the real line. If $f' > 0$ everywhere and $f > 0$ everywhere then $\lim_{x \to +\infty} f(x) = \infty$.

123. Let $f(x) = x^2 + 1$. Derive an exact formula for the derivative function $f'(x)$ by computing algebraically the limit of a difference quotient.

124. Let $f(x) = x^2 + 5$. Write an equation for the line tangent to the graph of $f(x) = x^2 + 5$ at the point where $x = 5$.

125. Approximate to 3 decimal places (with a difference quotient and a calculator) the derivative of $\sqrt{4x+1}$ at $x = 1$.

126. Find $f'(x)$ algebraically by using the limit definition if $f(x) = \dfrac{1}{x+6}$.

A) $\dfrac{1}{(x+6)^2}$ B) $\dfrac{-1}{(x+6)^2}$ C) $\dfrac{1}{x+6}$ D) 1

127. Using a calculator, estimate the derivative of $f(x) = \cos(x)$ at $x = 0$. Make sure your calculator is set to radians.

128. Using a calculator, estimate the derivative of $f(x) = -\cos(x)$ at $x = \pi$. Make sure your calculator is set to radians.

129. Give the difference quotient approximation to 2 decimal places of $f'(2)$ where $f(x) = \sqrt{x^3 + 5}$.

130. A. Give a difference quotient approximation (to one decimal place) of $f'(2)$ where $f(x) = \sqrt{x^2 + 21}$.

B. Find the equation of the line tangent to the graph of $f(x)$ at the point where $x = 2$.

131. Find the derivative of $g(x) = 3x^2 + 2x - 4$ at $x = 1$ algebraically.

132. Find the derivative of $m(x) = 2x^3$ at $x = 2$ algebraically.

Answer Key

1. 1.389
   section: 2.1
2. 7
   section: 2.1
3. $178.00
   section: 2.1
4. 0.26
   section: 2.1
5. increase
   section: 2.1
6. B
   section: 2.1

7A. A. 6
7B. B. 3
7C. C. 2
7D. D. 4
7E. E. 5
7F. F. 1
section: 2.1

8. –0.693
   section: 2.1
9. 5
   section: 2.1
10. 6.25
    section: 2.1

11A. 5
11B. –6.5
section: 2.1

12. B
    section: 2.1
13. negative
    section: 2.1
14. B
    section: 2.1
15. 0.93
    section: 2.1
16. B
    section: 2.1
17. –2.97
    section: 2.1
18. 25
    section: 2.1
19. A
    section: 2.1

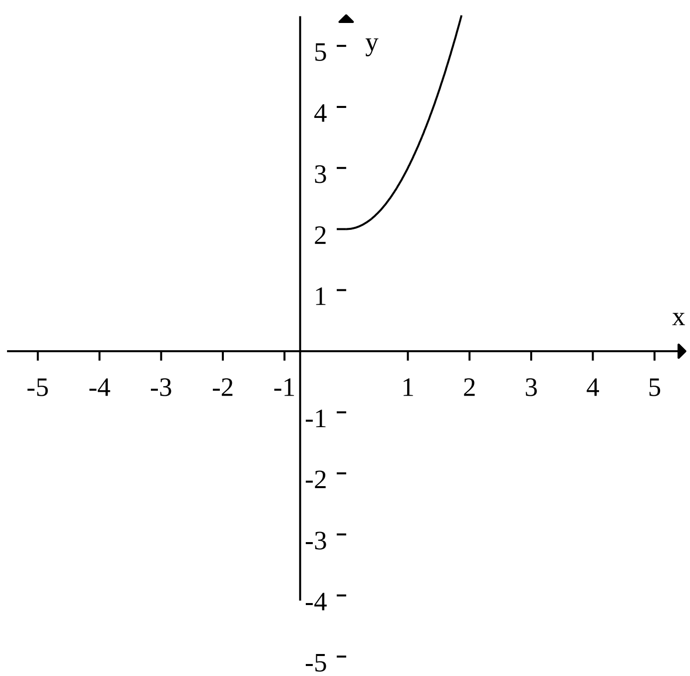
20A. A. 4
20B. B. 2
20C. C. 5
20D. D. 3
20E. E. 1
section: 2.1
21. 4.5
section: 2.2
22. $<$
section: 2.2
23. yes
section: 2.2
24. yes
section: 2.2
25. yes
section: 2.2
26. B
section: 2.2
27. A
section: 2.2
28. B
section: 2.2
29. increasing
section: 2.2
30. yes
section: 2.2
31. no
section: 2.2
32A. $\dfrac{\text{minutes}}{\text{pound}}$
32B. $\dfrac{\text{minutes}}{\text{pound}^2}$
section: 2.2
33. A
section: 2.2
34. 24.5
section: 2.3
35. yes
section: 2.3
36. B
section: 2.3
37. C
section: 2.3
38. B
section: 2.3
39. A

section: 2.3
40. $12.34
section: 2.3
41. C
section: 2.3
42. A
section: 2.3
43. B
section: 2.3
44. B
section: 2.3
45. A
section: 2.3
46. A
section: 2.3
47. –160
section: 2.3
48. –1
section: 2.3
49. A
section: 2.3
50. D
section: 2.3
51. A
section: 2.3
52. C
section: 2.3
53. The amount charged per hour when the client orders 90 is 76 .
section: 2.3
54A. The consultant charges $70 for 10 hours of work.
54B. The cost per hour will go down by $5 for the next 10 hours added to the contract.
section: 2.3
55. B
section: 2.3
56. C
section: 2.3
57. 30,125
section: 2.3
58. B
section: 2.3
59. A
section: 2.4
60. A
section: 2.4
61. positive
section: 2.4

62. positive
section: 2.4
63. positive
section: 2.4
64. A, B
section: 2.4
65A. 5
65B. 14.5
section: 2.4
66. B
section: 2.4
67. no
section: 2.4
68. A, B, C
section: 2.4
69. A, B
section: 2.4
70. A
section: 2.4
71A. positive
71B. negative
section: 2.4
72. negative
section: 2.4
73. positive
section: 2.4
74. positive
section: 2.4
75. negative
section: 2.4
76. $\dfrac{dA}{dx}\ \dfrac{\text{thousands of dollars}}{\text{seconds}}$, $\dfrac{d^2A}{dx^2}\ \dfrac{\text{thousands of dollars}}{\text{seconds}^2}$
section: 2.4
77A. $>$
77B. $>$
section: 2.4
78. negative
section: 2.4
79. 10
section: 2.4
80. A
section: 2.5
81. A, D
section: 2.5
82. B
section: 2.5

83. C
section: 2.5
84. A
section: 2.5
85. D
section: 2.5
86. $8350
section: 2.5
87. 251
section: 2.5
88A. A. $\pi = -25p^2 + 3250p - 108,000$
88B. B. $65
section: 2.5
89. C
section: 2.5
90. A
section: 2.5
91. 3
section: 2.5
92. 3
section: 2.5
93. $4
section: 2.5
94. 3000
section: 2.5
95. True
section: 2.5
96. 46
section: 2.5
97. 23
section: 2.5
98. 39
section: 2.5
99. A
section: 2.5
100A. 1
100B. 3
100C. 4
100D. 2
100E. 5
section: 2 review
101A. A. positive
101B. B. negative
101C. C. 17
section: 2 review
102A. A. positive

102B. B. negative
section: 2 review
103. B
section: 2 review
104. A
section: 2 review
105. positive
section: 2 review
106. A
section: 2 review
107. –8
section: 2 review
108. 3
section: 2 review
109. A
section: 2 review
110. B
section: 2 review
111. yes
section: 2 review
112.



section: 2 review
113. F
section: 2 review
114A. $3.1348 \dfrac{\text{million songs}}{\text{day}}$

114B. 2639.50 million songs
section: 2 review
115. 0.40
section: limits.....
116. D
section: limits.....
117. False
section: limits.....
118. True
section: limits.....
119. True
section: limits.....
120. True
section: limits.....
121. True
section: limits.....
122. False
section: limits.....
123. $2x$
section: limits.....
124. $y = 10x - 20$
section: limits.....
125. 0.894
section: limits.....
126. B
section: limits.....
127. 0
section: limits.....
128. 0
section: limits.....
129. 1.66
section: limits.....
130A. A. 0.4
130B. B. $y = 0.4x + 4.2$
section: limits.....
131. 8
section: limits.....
132. 24
section: limits.....