Test Bank for Applied Calculus 6th Edition by Hughes-Hallett

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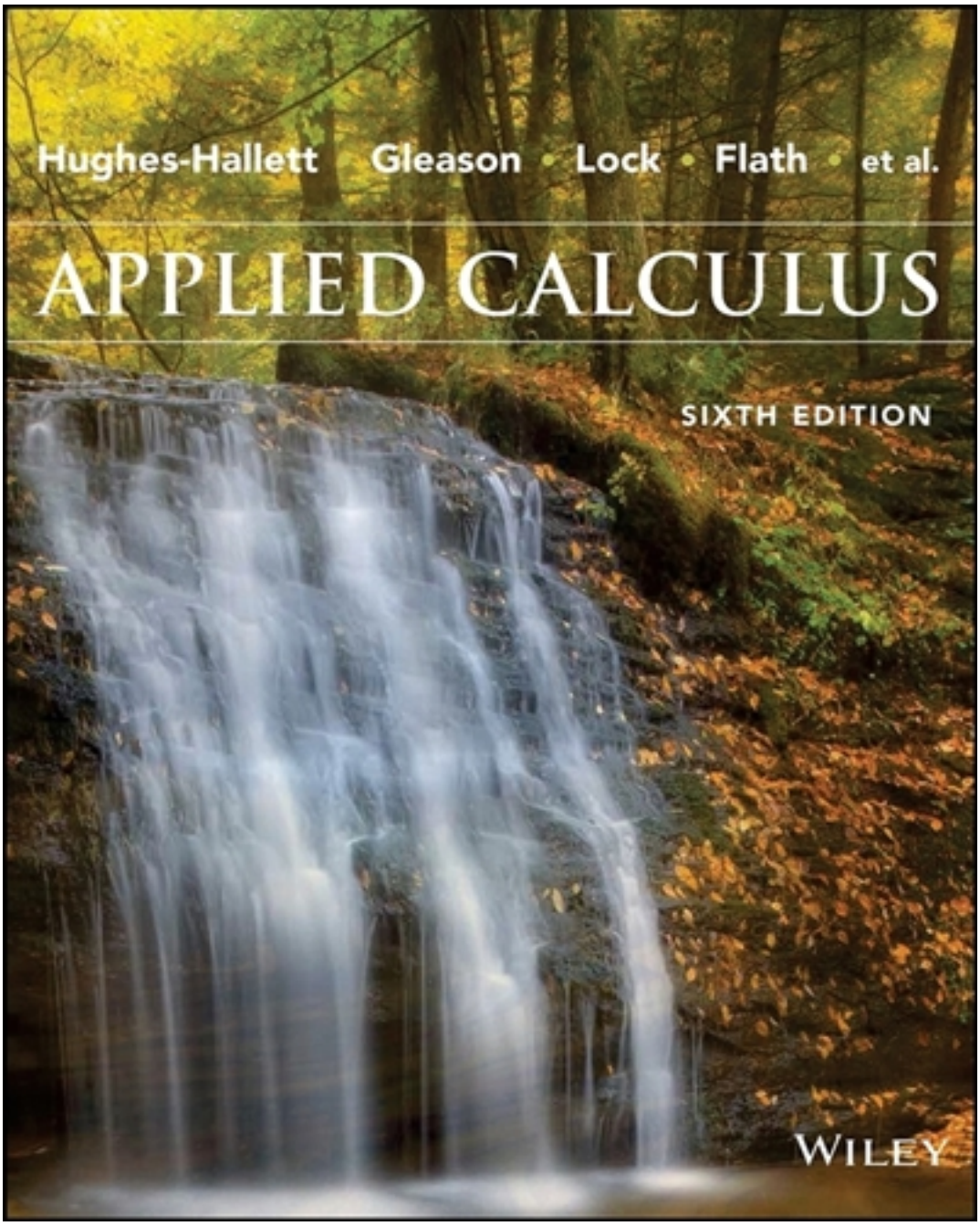


Test Bank

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*=3.2 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

Ans: 1.563
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

2. Let $f(t) = t^2 + t$. What is the change in $f(t)$ between *t*=2 and *t*=5?
Ans: 24
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

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 1980 and 1990 is _____ per year.

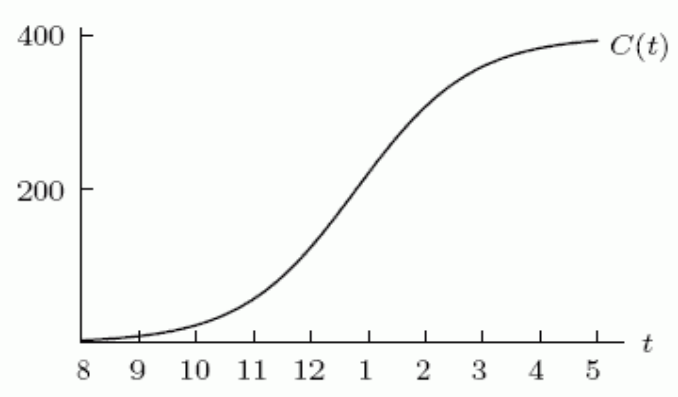
Year	1970	1975	1980	1985	1990	1995
Capital	500	966	1856	3578	6876	13,233

Ans: $502.00
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

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.
Ans: 0.26
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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?
Ans: increase
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

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?

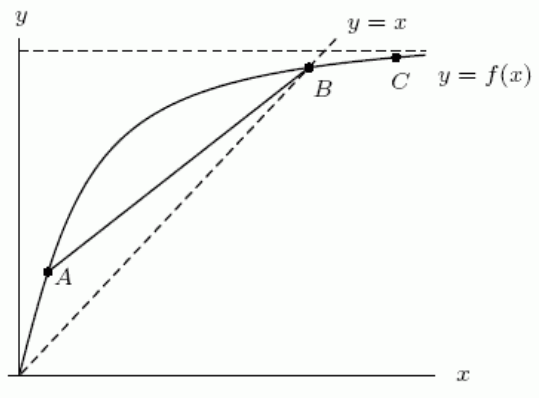


A) 11am
B) 1pm
C) 3pm
D) 5pm

Ans: B Learning Objectives: Understand instantaneous rate of change/derivative graphically. difficulty: easy section: 2.1

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



Part A: A. 6
Part B: B. 3
Part C: C. 2
Part D: D. 4
Part E: E. 5
Part F: F. 1
Learning Objectives: Understand instantaneous rate of change/derivative graphically.
difficulty: easy section: 2.1

8. Estimate $f'(0)$ when $f(x) = 3^{-x}$. Take smaller and smaller intervals until your estimate is accurate to 3 decimal places.
Ans: –1.099
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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

Ans: 5
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

10. Given the following data about the function f, give the average rate of change of f between x=3.2 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

Ans: 6.17
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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

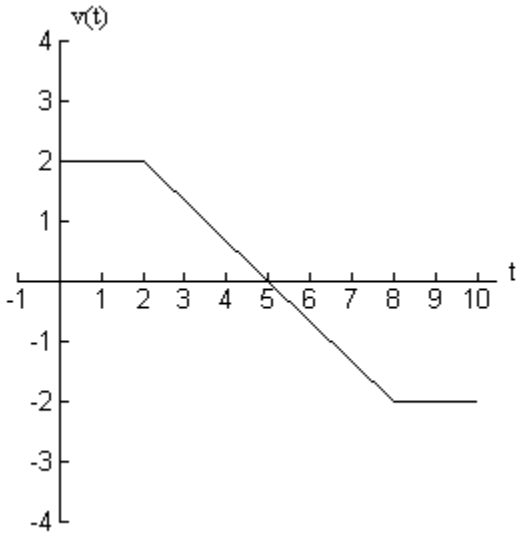
Part A: 5
Part B: –6.5
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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

A) 3
B) 4
C) 5
D) 6

Ans: B Learning Objectives: Understand instantaneous rate of change/derivative numerically. difficulty: easy section: 2.1

13. Given the graph below of $y = v(t)$, is $v'(9)$ positive, negative, zero or undefined?



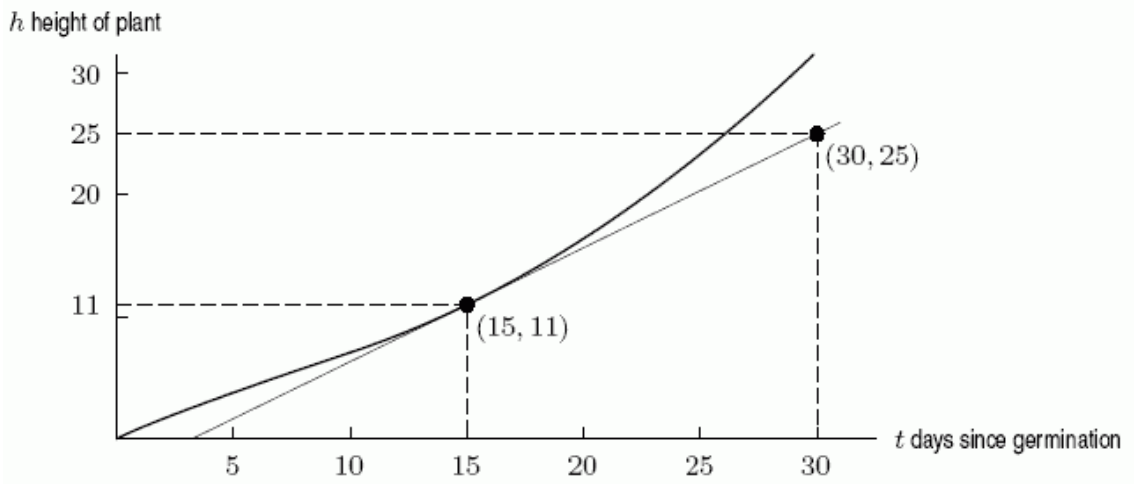
Ans: zero
Learning Objectives: Understand instantaneous rate of change/derivative graphically.
difficulty: easy section: 2.1

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

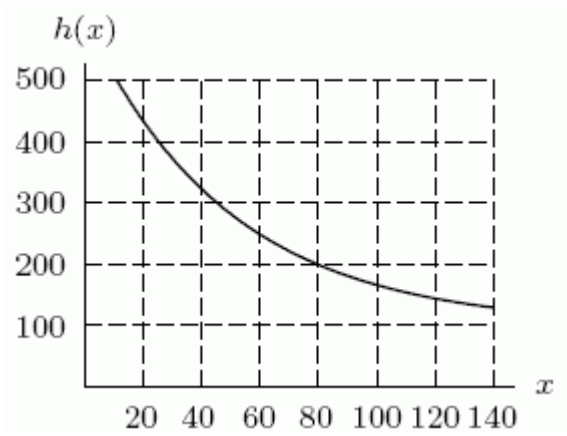
Ans: B Learning Objectives: Understand what the derivative conveys graphically.
difficulty: easy section: 2.2

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.



Ans: 0.93
Learning Objectives: Understand instantaneous rate of change/derivative graphically.
difficulty: medium section: 2.1

16. From the following graph, estimate $f'(80)$.



A) –3.25
B) –2.25
C) –1.25
D) –0.25
Ans: B Learning Objectives: Understand instantaneous rate of change/derivative graphically. difficulty: medium section: 2.1

17. Using a difference quotient, compute $f'(1)$ to 2 decimal places for $f(x) = \sin(3x)$.
Ans: –2.97
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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

Ans: 25
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.1

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.
Ans: A Learning Objectives: Understand instantaneous rate of change/derivative numerically. difficulty: easy section: 2.1

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.

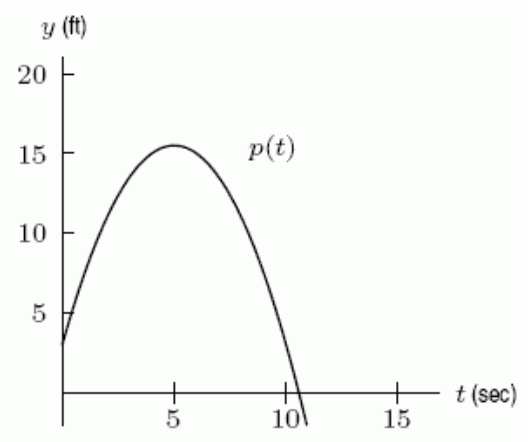
A. average velocity on $1 \le t \le 3$.

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.



Part A: A. 4
Part B: B. 2
Part C: C. 5
Part D: D. 3
Part E: E. 1
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: medium section: 2.1

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

Ans: 4.5
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2.2

22. Using the following table, tell whether $f'(-1)$ 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

Ans: =
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: easy section: 2.2

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.

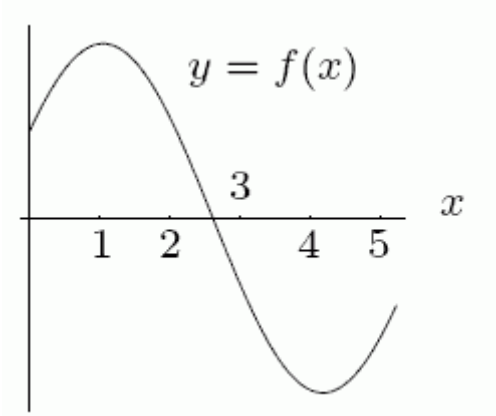
Is it possible that $N(7) = 1150$?
Ans: yes
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2.2

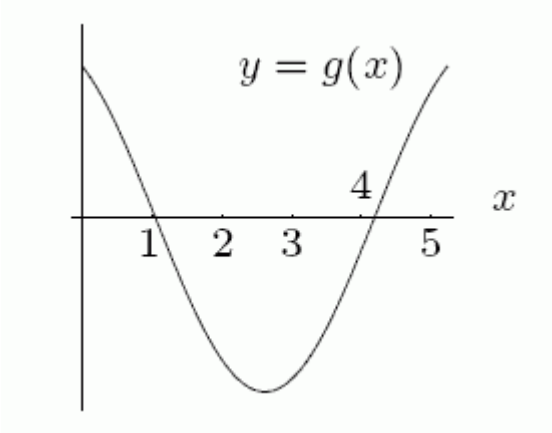
24. A certain bacterial colony was observed for several hours and the following conditions were reported. Let $N(t)$ be the number of bacteria present after t hours.

- 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 $N'(7) = 0$?
Ans: yes
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2.2

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

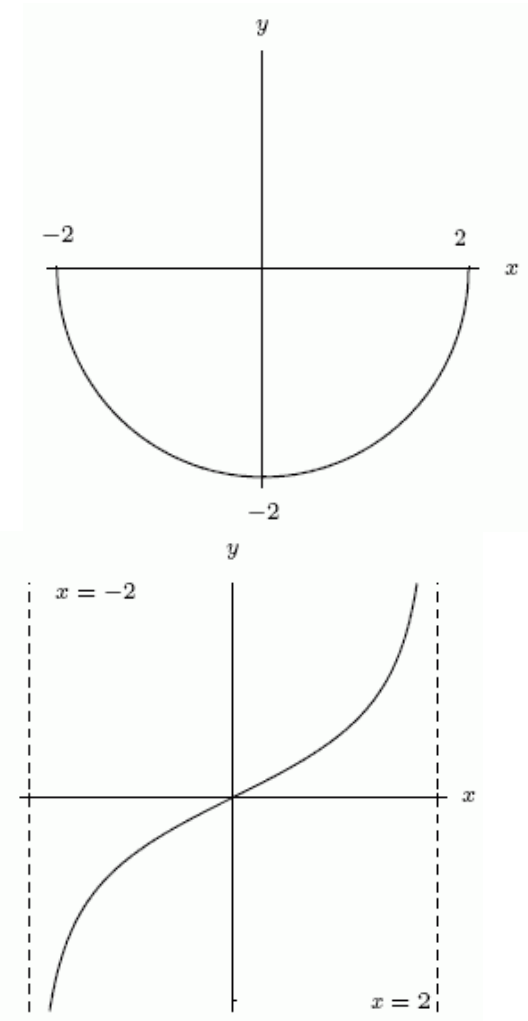




Ans: no
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

26. Consider the two functions shown below.

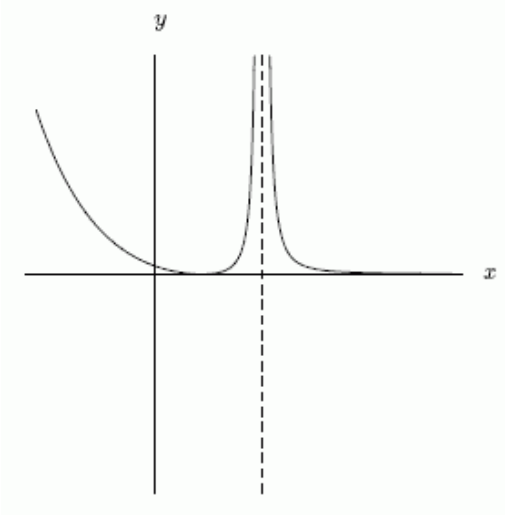
A. B.



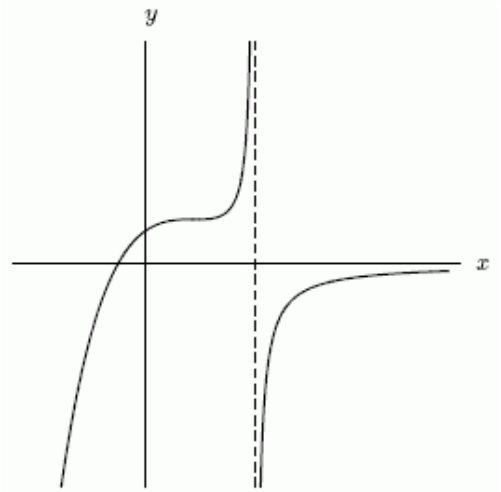
A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.
Ans: B Learning Objectives: Estimate the derivative of a function given graphically. difficulty: easy section: 2.2

27. Consider the two functions shown below.

A.



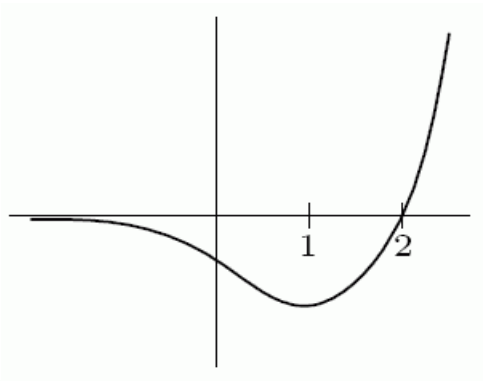
B.



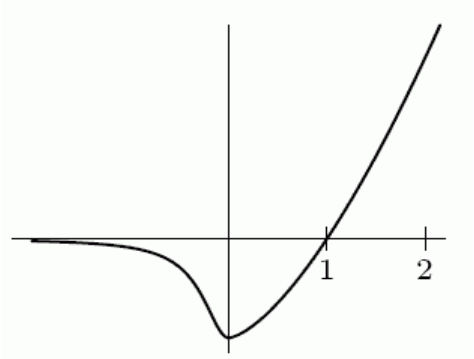
A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.
Ans: A Learning Objectives: Estimate the derivative of a function given graphically. difficulty: medium section: 2.2

28. Consider the two functions shown below.

A.

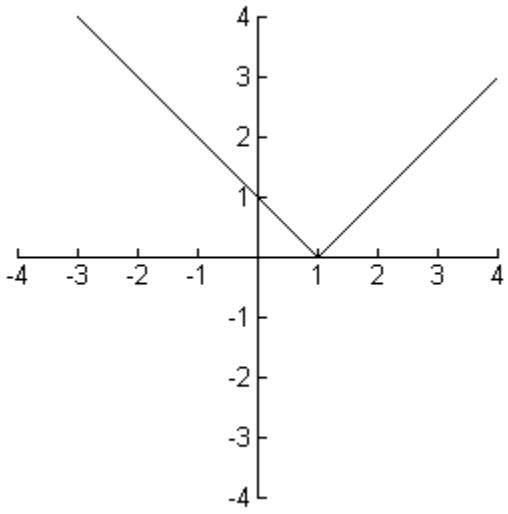


B.



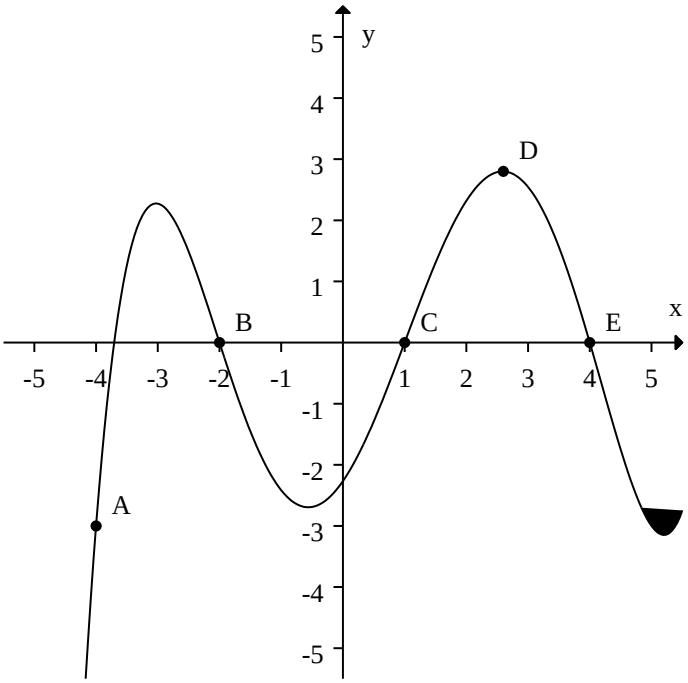
A) The function in graph A is the derivative of the function in graph B.
B) The function in graph B is the derivative of the function in graph A.
C) Neither function is the derivative of the other.
Ans: B Learning Objectives: Estimate the derivative of a function given graphically. difficulty: easy section: 2.2

29. The graph below is the graph of $M'(x)$, the *derivative* of $M(x)$. At 2 is the original function $M(x)$ increasing, decreasing, constant or undefined?



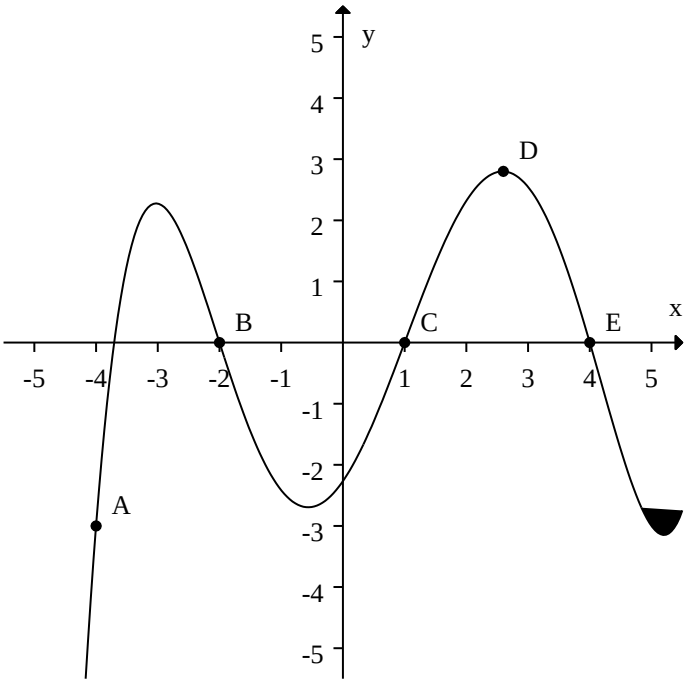
Ans: increasing
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

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



Ans: yes
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

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

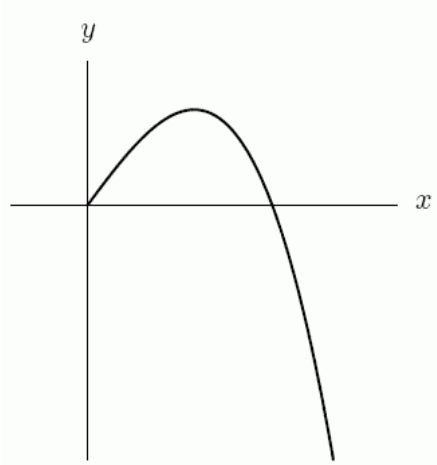


Ans: yes
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

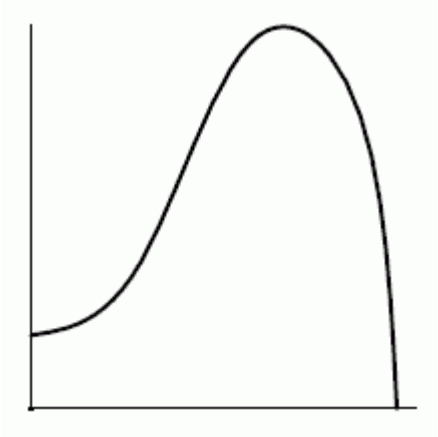
32. The distance that a bird flies is measured by y miles for x minutes, and is given by the function $y = f(x)$. What are the units of A) $f'(10)$ and B) $f''(10)$?
Part A: $\frac{\text{miles}}{\text{minute}}$
Part B: $\frac{\text{miles}}{\text{minute}^2}$
Learning Objectives: Use units to interpret the derivative. difficulty: easy
section: 2.3

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.
Ans: A Learning Objectives: Estimate the derivative of a function given graphically. difficulty: easy section: 2.2

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 $g(55) = 34$ and $g'(55) = -0.54$. What would you expect $g(56)$ to be?
Ans: 33.46
Learning Objectives: Use derivatives to estimate the value of a function.
difficulty: easy section: 2.3

35. Suppose $g(t)$ is the height in inches of a person who is t years old. Is it reasonable that $g(30) = 70$?
Ans: yes
Learning Objectives: Use units to interpret the derivative. difficulty: easy
section: 2.3

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 70 meters above the surface of the earth, in degrees per meter?
A) $t(70)$
B) $t'(70)$
C) h such that $t(h) = 70$
D) h such that $t'(h) = 70$
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

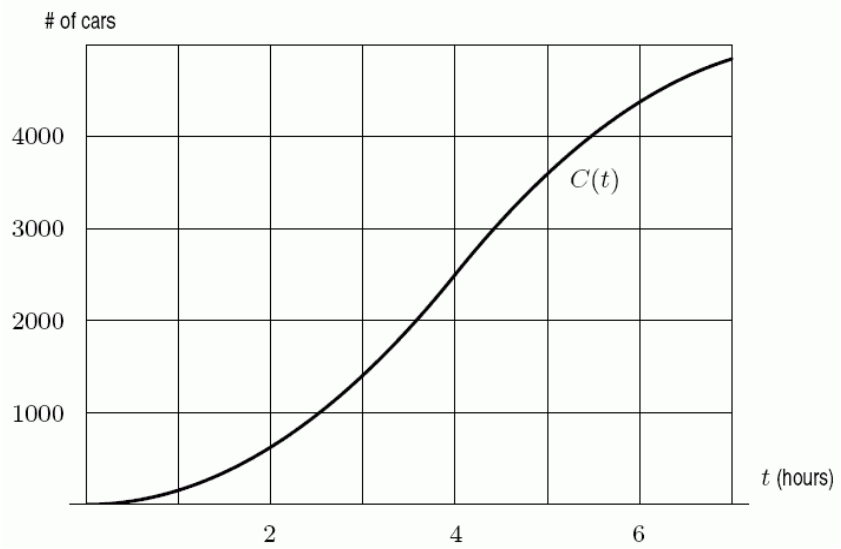
37. Suppose $g(t)$ is the height in inches of a person who is t years old. Would you expect $g'(45)$ to be
A) greater than 0
B) less than 0
C) equal to 0
Ans: C Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

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
Ans: A Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

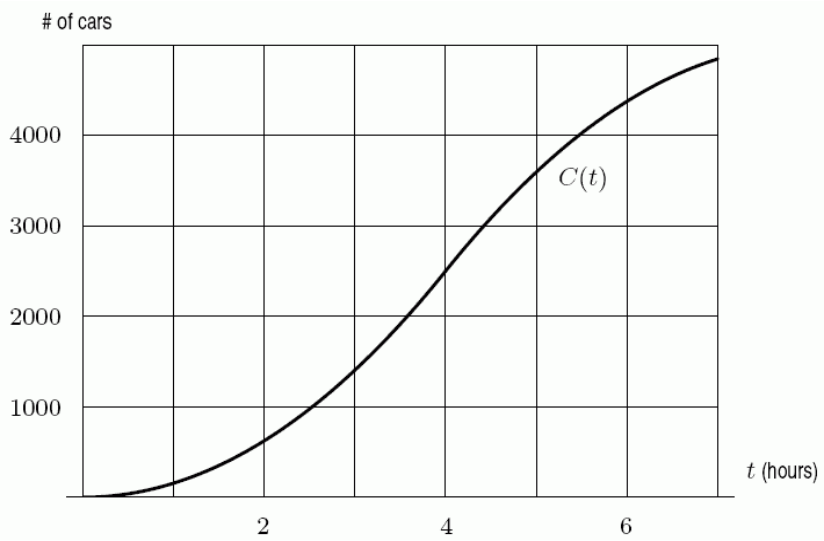
40. Suppose that $f(T)$ is the cost to heat my house, in dollars per day, when the outside temperature is T° Fahrenheit. If $f(23) = 11.93$ and $f'(23) = -0.17$, approximately what is the cost to heat my house when the temperature is 20°F?
Ans: \$12.44
Learning Objectives: Use derivatives to estimate the value of a function.
difficulty: medium section: 2.3

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.
Ans: C Learning Objectives: Understand relative rate of change.
difficulty: easy section: 2.3

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
Ans: A Learning Objectives: Understand relative rate of change.
difficulty: easy section: 2.3

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 21 inches?
A) $L(21)$
B) $L'(21)$
C) r such that $L(r) = 21$
D) r such that $L'(r) = 21$
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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"
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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
Ans: A Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

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
Ans: A Learning Objectives: Understand relative rate of change.
difficulty: easy section: 2.3

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 $f'(750)$. 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

Ans: –40
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: easy section: 2.2

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

Ans: –1
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: easy section: 2.2

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 1000 meters?
A) $t(1000)$
B) $t'(1000)$
C) h such that $t(h) = 1000$
D) h such that $t'(h) = 1000$
Ans: A Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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 25 degrees per meter?
A) $t(25)$
B) $t'(25)$
C) h such that $t(h) = 25$
D) h such that $t'(h) = 25$
Ans: D Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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 $L'(r) = 8$
Ans: A Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

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) of a tree that produces 150 board-feet of lumber ?
A) $L(150)$
B) $L'(150)$
C) r such that $L(r) = 150$
D) r such that $L'(r) = 150$
Ans: C Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

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 130 hours of work.
Ans: The amount charged per hour when the client orders 130 is 116 .
Learning Objectives: Use units to interpret the derivative. difficulty: easy
section: 2.3

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) $C(10) = 100$.

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

Part A: The consultant charges $100 for 10 hours of work.
Part B: The cost per hour will go down by $5 for the next 10 hours added to the contract.
Learning Objectives: Use units to interpret the derivative. difficulty: medium
section: 2.3

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 600 meters away from the speakers?
A) $f(600)$
B) $f'(600)$
C) *d* such that $f(d) = 600$
D) *d* such that $f'(d) = 600$
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: medium section: 2.3

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 $f'(d) = 80$
Ans: C Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

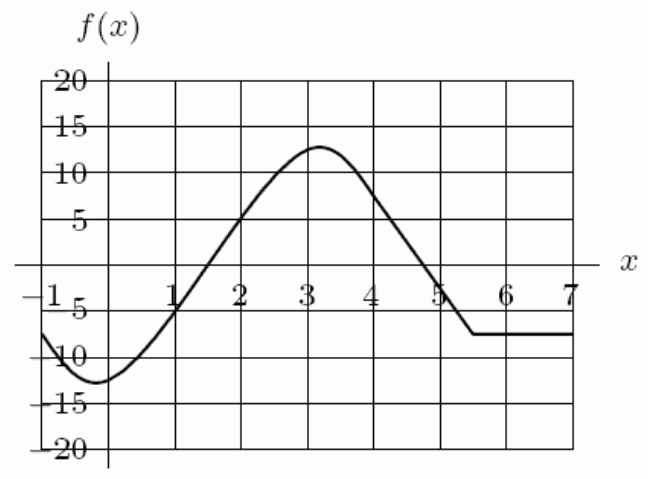
57. The population of a certain town is given by the function $P(t)$ where t is the number of years since the town was incorporated. If $P'(t)$ is constant for t >185, what will $P(200)$ be if $P(185) = 46,000$ and $P'(185) = 225$?
Ans: 49,375
Learning Objectives: Use derivatives to estimate the value of a function.
difficulty: easy section: 2.3

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

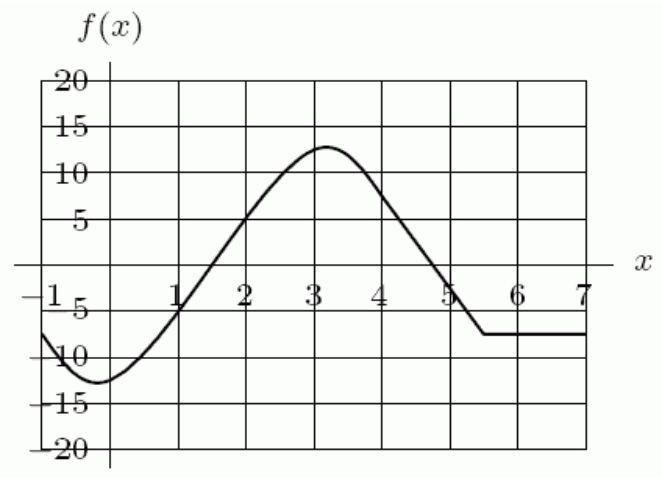
A) mph/$^\circ$F
B) $^\circ$F/mph
Ans: B Learning Objectives: Use units to interpret the derivative.
difficulty: easy section: 2.3

59. The graph of $f(x)$ is shown in the following figure. Give an estimate for $f'(4)$



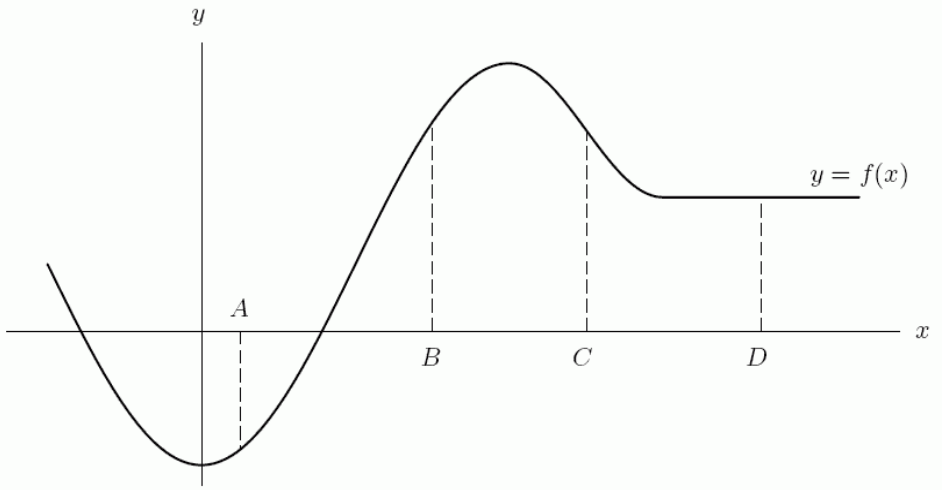
A) –10
B) 10
C) –20
D) 20
Ans: A Learning Objectives: Estimate the derivative of a function given graphically. difficulty: medium section: 2.2

60. The graph of $f(x)$ is shown in the following figure. Is $f''(4.5)$ positive, negative, or zero?



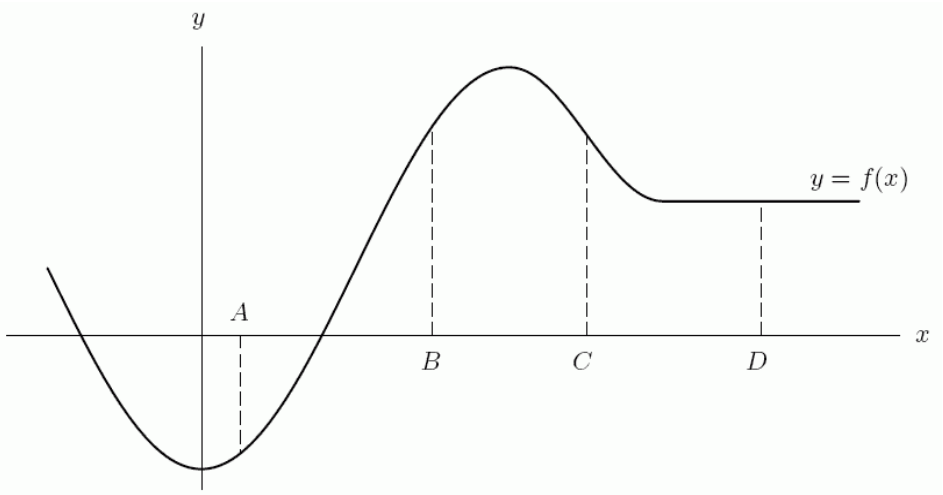
A) zero
B) positive
C) negative
Ans: A Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2.4

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



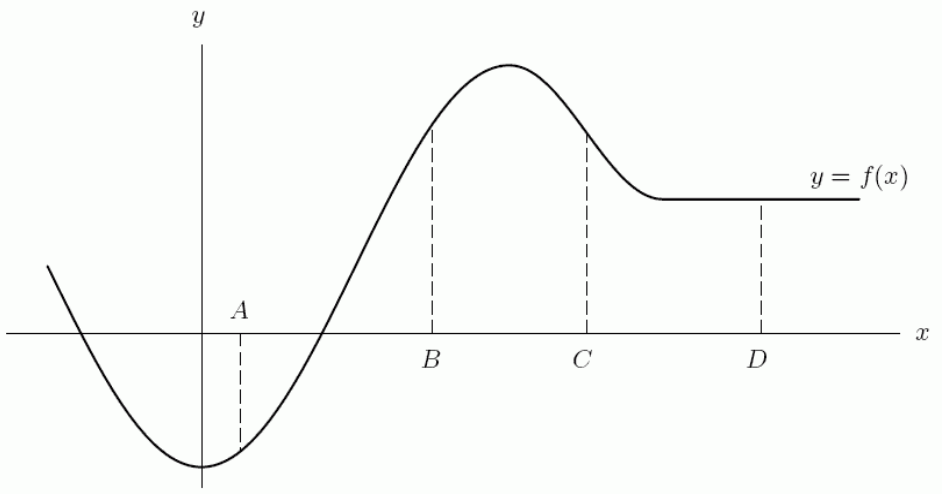
Ans: positive
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 1.1

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



Ans: positive
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

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



Ans: positive
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2.4

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) 8
C) 14

Ans: A, B Learning Objectives: Understand what the second derivative conveys graphically. difficulty: medium section: 2.4

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

Part A: 5
Part B: 14.5
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2.2

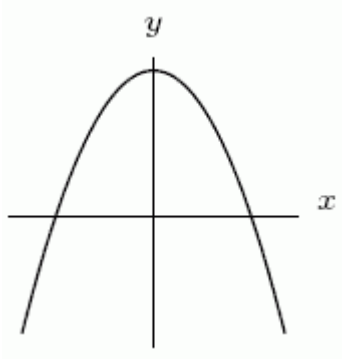
66. Suppose a function is given by the following table of values. Is f'' most likely positive or negative at x=1.9?

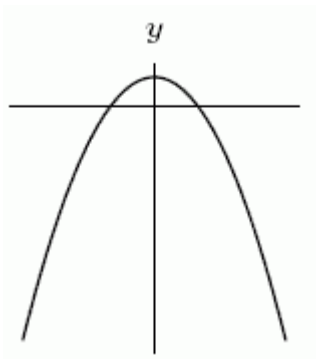
x	1.1	1.3	1.5	1.7	1.9	2.1
$f(x)$	12	15	21	23	24	25

A) positive
B) negative

Ans: B Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2.4

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





Ans: no
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2.4

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) $C''(t)$
Ans: A, B, C Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2.4

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) $C''(t)$
Ans: A, B Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2.4

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.

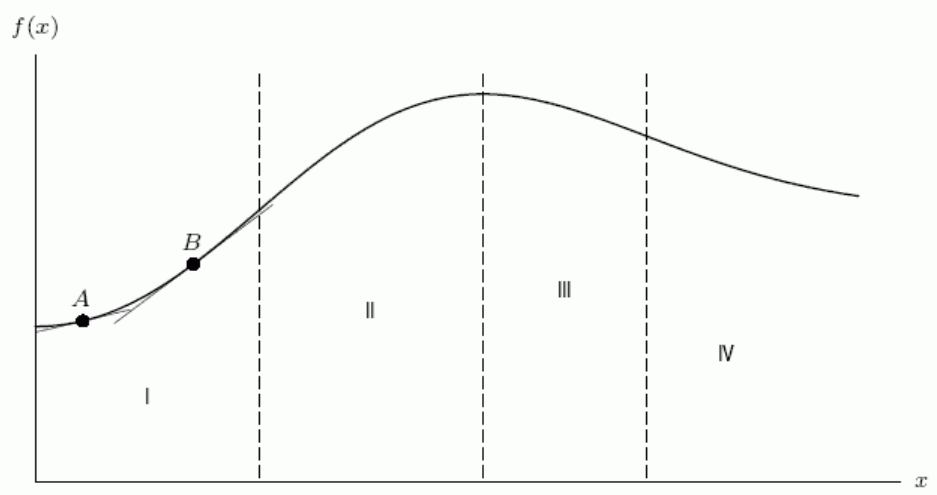
A) $C(t)$

B) $C'(t)$

C) $C''(t)$

Ans: A Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2.4

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

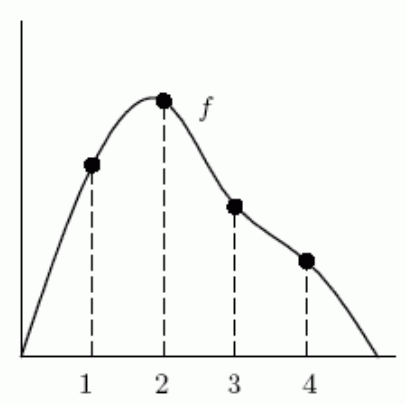


Part A: negative

Part B: negative

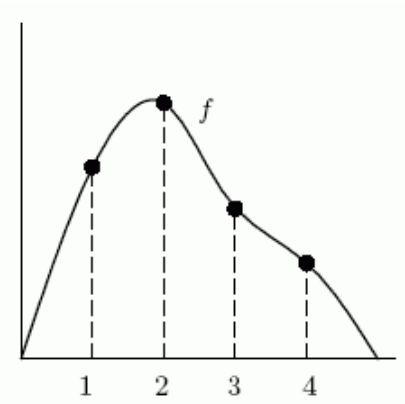
Learning Objectives: Estimate the derivative of a function given graphically. difficulty: easy section: 2.4

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?



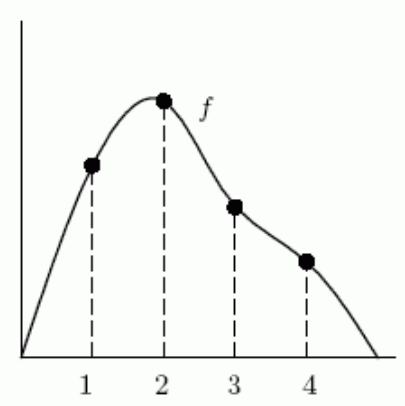
Ans: negative
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

73. Consider the function f sketched in the following figure. Do you expect $f'(2)$ to be positive, negative, or zero?



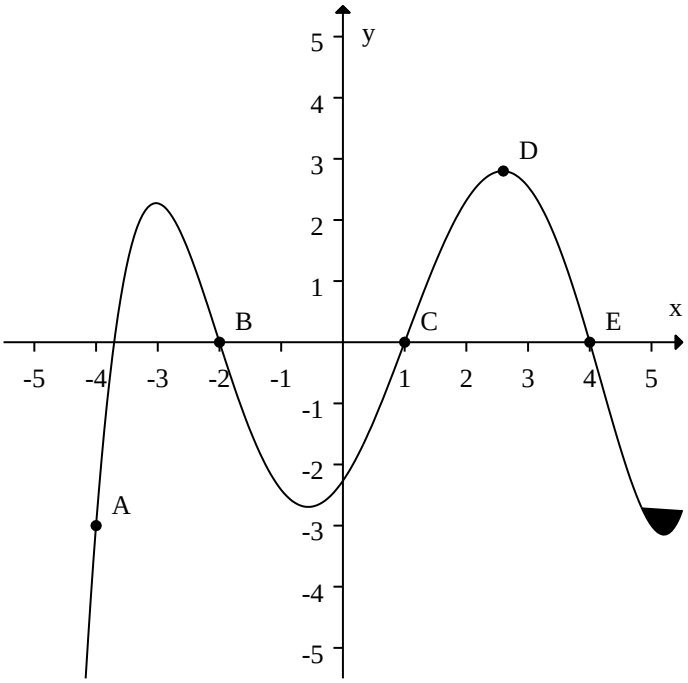
Ans: negative
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2.2

74. Consider the function f sketched in the following figure. Do you expect $f''(4)$ to be positive, negative, or zero?



Ans: negative
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2.4

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



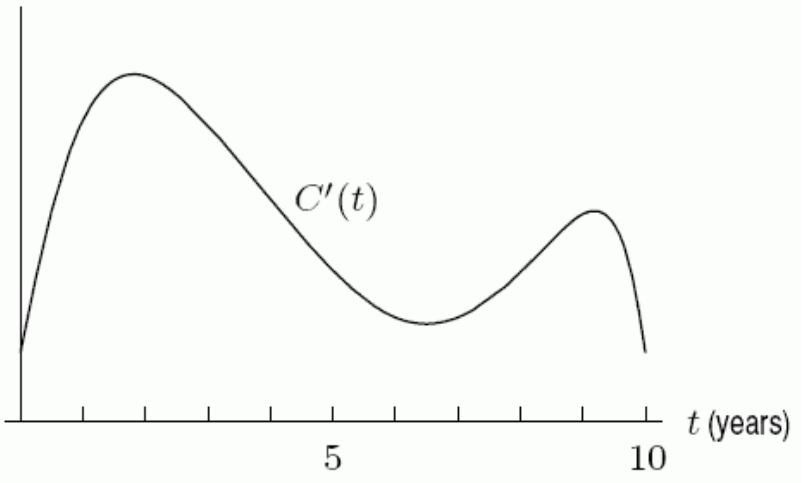
Ans: negative
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2.4

76. Write the Leibniz notation for the first and second derivatives of the given function and include units.
"The amount of paint, G, in gallons, is a function of time m, in minutes"
Ans: $\frac{d\,\mathrm{G}}{d\,\mathrm{m}}\ \frac{\text{gallons}}{\text{minutes}}$, $\frac{d^2\,\mathrm{G}}{d\,\mathrm{m}^2}\ \frac{\text{gallons}}{\text{minutes}^2}$
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: medium section: 2.4

77. Let $S(t)$ represent the number of students enrolled in school in the year t. If enrollment is decreasing steadily, then ds/dt _____0 and d^2s/dt^2 _____0. (Enter "<",">", or "=")
Part A: <
Part B: =
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: medium section: 2.4

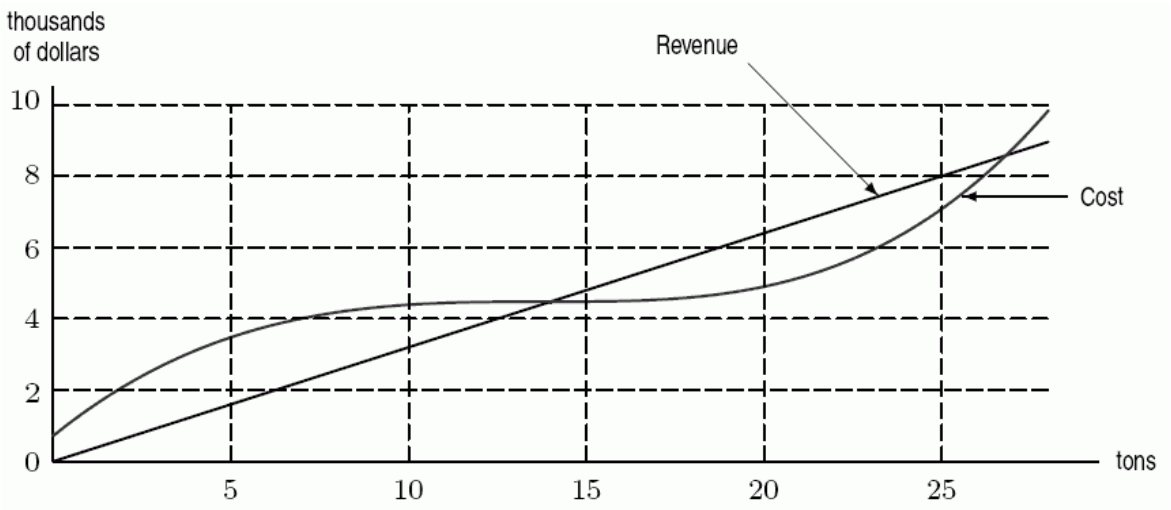
78. A driver obeys the speed limit as she travels past different towns in the order *A*, *B*, *C*. In town *A*, the speed limit is 35 mph. In town *B*, the speed limit is 60 mph, and in town *C* the speed limit is 55 mph. It always takes her two minutes to reach the new speed limit when she passes by 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?
Ans: positive
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: medium section: 2.4

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?



Ans: 1
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2.4

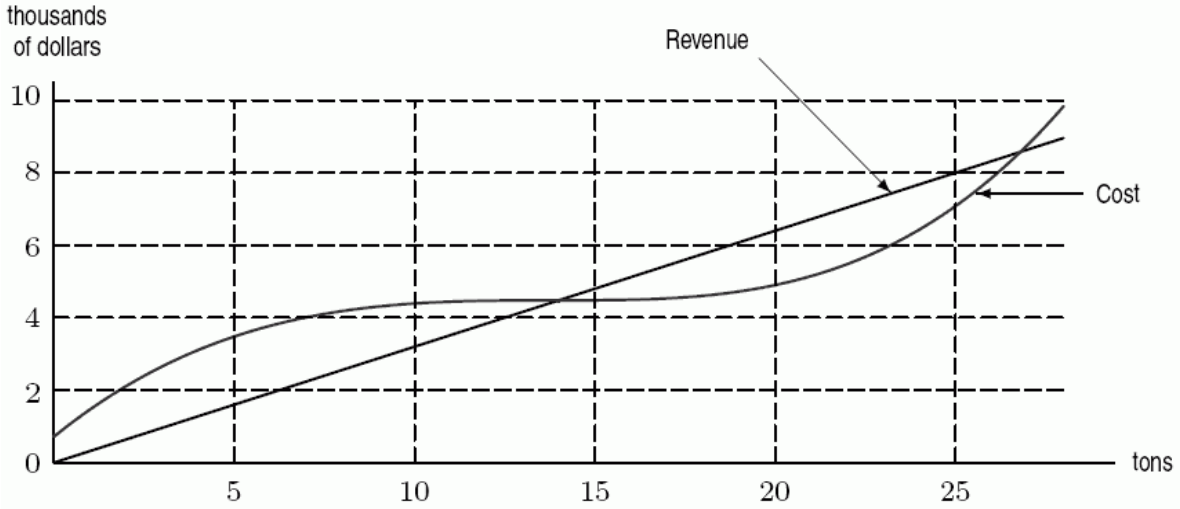
80. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. How much does it cost to produce 10 tons?



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

Ans: A Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: easy section: 2.5

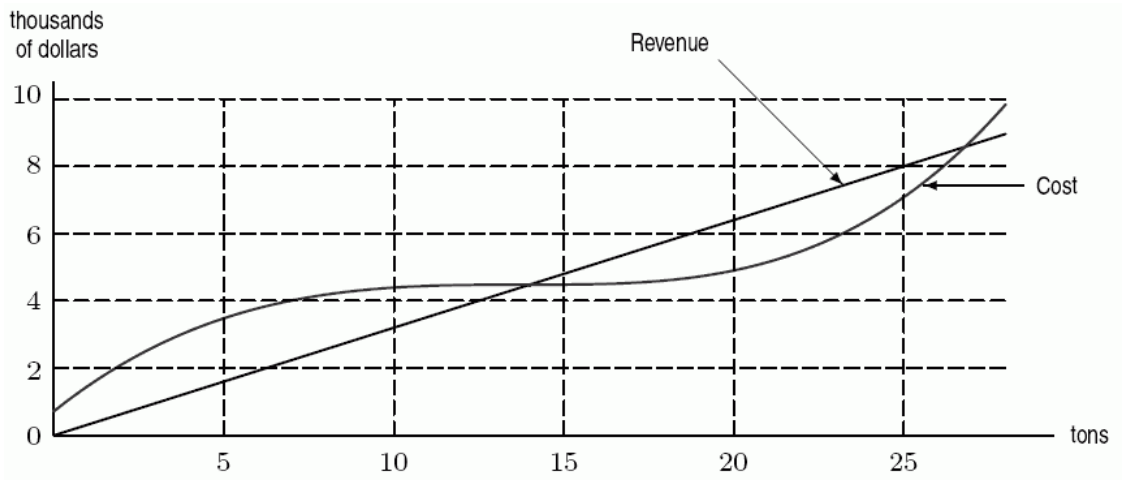
81. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. When does Revenue=Cost?



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

Ans: A, D Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: easy section: 2.5

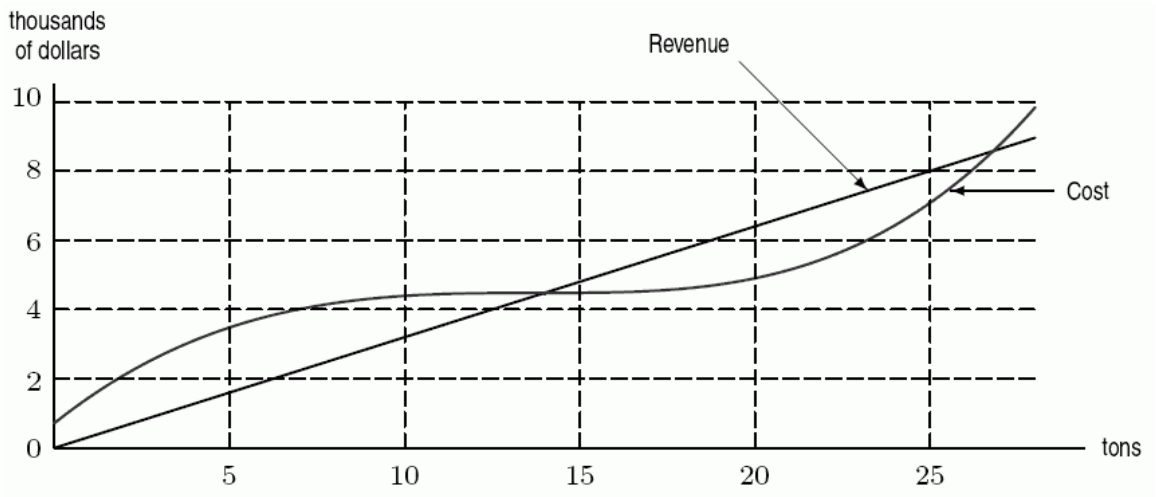
82. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. Marginal revenue at 20 tons is about how much?



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

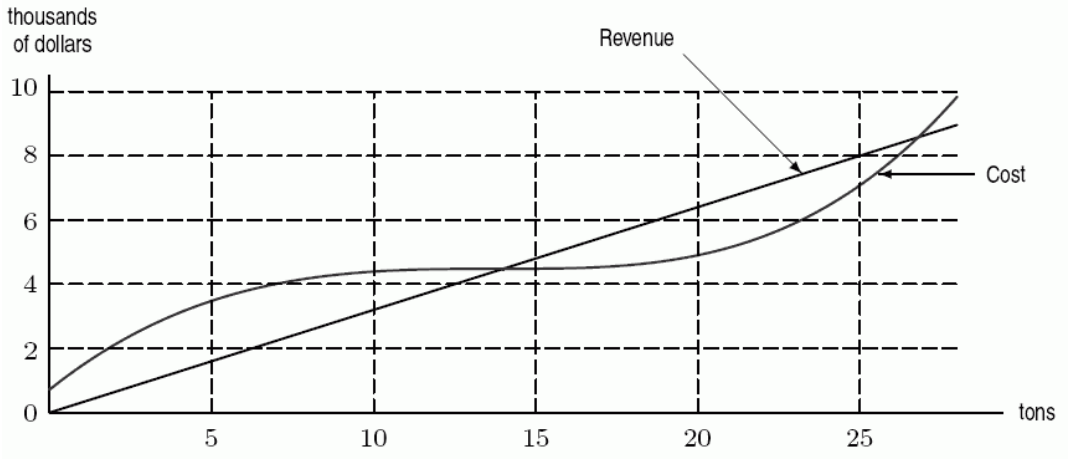
Ans: B Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: easy section: 2.5

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



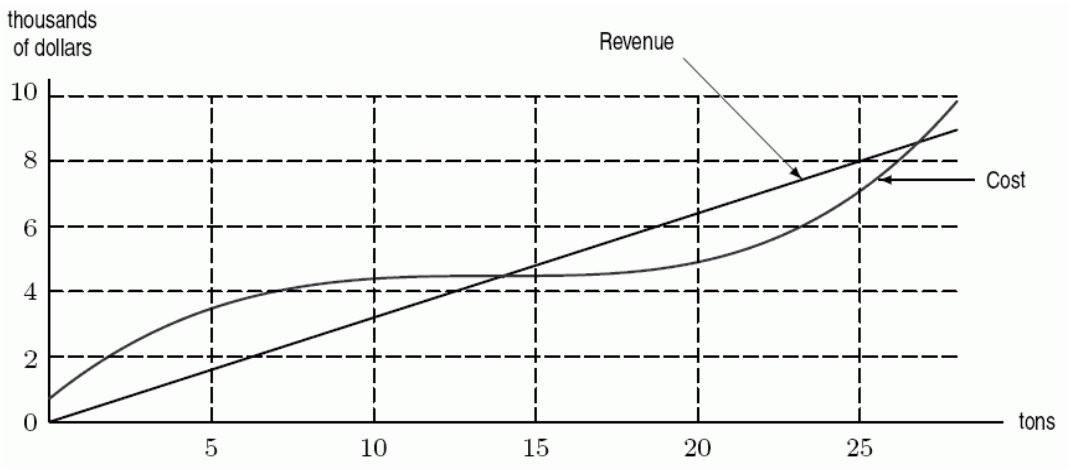
A) $4,300/ton
B) $8,300/ton
C) $320/ton
D) $500/ton
Ans: C Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: easy section: 2.5

84. Cost and revenue functions for a certain chemical manufacturer are given in the following figure. Should the company increase production beyond 25 tons?



A) no
B) yes
Ans: A Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: medium section: 2.5

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
Ans: D Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: medium section: 2.5

86. To produce 250 items the total cost is $4600 and the marginal cost is $11. Estimate the cost of producing 500 items.
Ans: $7350
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: medium section: 2.5

87. To produce 250 items the total cost is $4700 and the marginal cost is $15. Which estimate is more likely to be accurate, one for producing 251 items, or one for producing 500 items?
Ans: 251
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: easy section: 2.5

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.

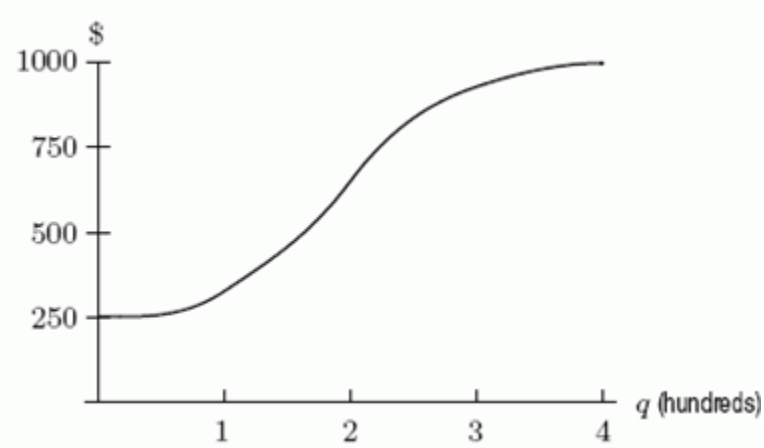
B. Sketch the profit function to determine what price yields the largest profit. What is that price?

Part A: A. $\pi = -25p^2 + 3250p - 108,000$

Part B: B. \$65

Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: medium section: 2.5

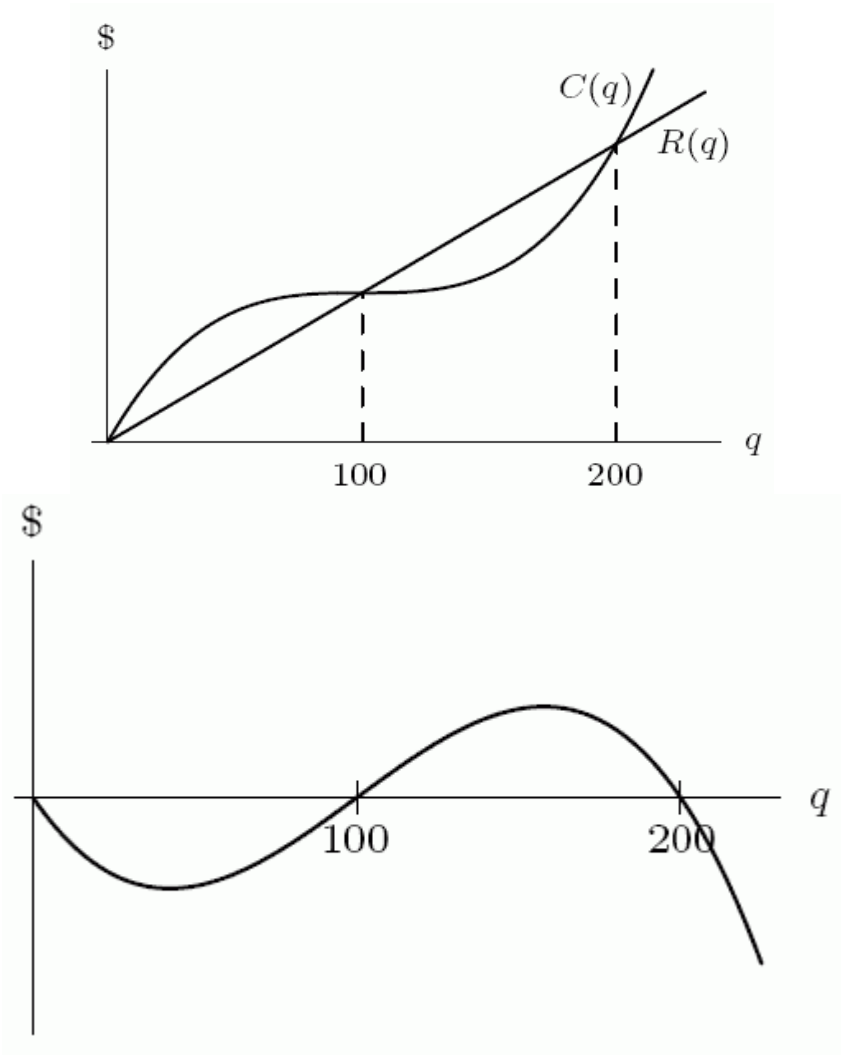
89. The graph of a cost function is given in the following figure. Which item costs the most to produce?



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

Ans: C Learning Objectives: Understand marginal analysis. difficulty: easy section: 2.5

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



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

Ans: A Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: medium section: 2.5

91. Given the following table, find $\pi(3)$.

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

Ans: 1
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: easy section: 2.5

92. Given the following table, find $MC(2)$.

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

Ans: 1
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: medium section: 2.5

93. The following table gives the cost and revenue, in dollars, for different production levels, q. What are the fixed costs?

q (units)	0	1000	2000	3000	4000	5000
$R(q)$ (dollars)	0	4000	8000	12,000	16,000	20,000
$C(q)$ (dollars)	1700	5000	8000	10,000	15,000	24,000

Ans: $1700
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue.
difficulty: medium section: 2.5

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)	1200	4000	6000	7000	11,000	19,000

Ans: 3000
Learning Objectives: Understand marginal analysis. difficulty: medium
section: 2.5

95. A newspaper headline recently read , " Taxes are increasing at an decreasing rate". This says that the second derivative is negative.
A) True
B) False
Ans: A Learning Objectives: Understand marginal analysis. difficulty: easy section: 2.5

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 $3.47 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?
Ans: 47
Learning Objectives: Understand cost, marginal cost, revenue and marginal revenue. difficulty: hard section: 2.5

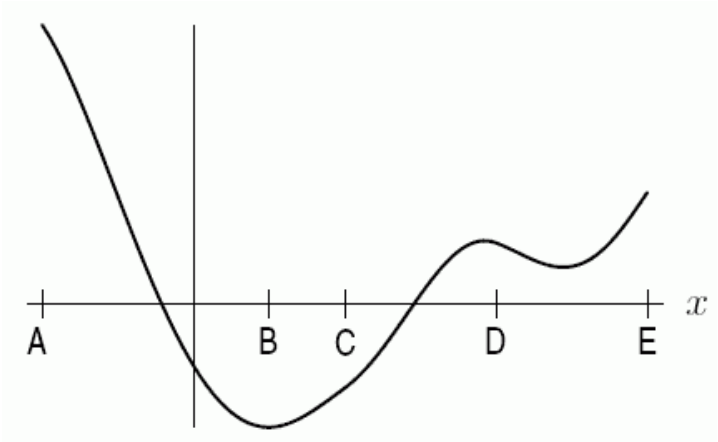
97. Your friend Herman operates a neighborhood lemonade stand. . Last month he spent $2 and made 19 glasses of lemonade, and another time he spent $5 and made 83 glasses of lemonade. You decide to use this data to create a linear cost function, $C(q)$, giving the cost in dollars of making q glasses of lemonade. If lemonade sells for $0.15 per glass, how many glasses must he sell to break even?
Ans: 12
Learning Objectives: Understand marginal analysis. difficulty: medium section: 2.5

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 $3.12 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?
Ans: 32
Learning Objectives: Understand marginal analysis. difficulty: medium section: 2.5

99. At a production level of 2000 for a product, marginal revenue is \$3.50 per unit and marginal cost is \$3.00 per unit. Do you expect maximum profit to occur at a production level above or below 2000?
A) above
B) below
Ans: A Learning Objectives: Understand marginal analysis.
difficulty: medium section: 2.5

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. $f'(E)$



Part A: 1
Part B: 3
Part C: 4
Part D: 2
Part E: 5
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: medium section: 2 review

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 $f'(4)$ by averaging the approximations from either side.

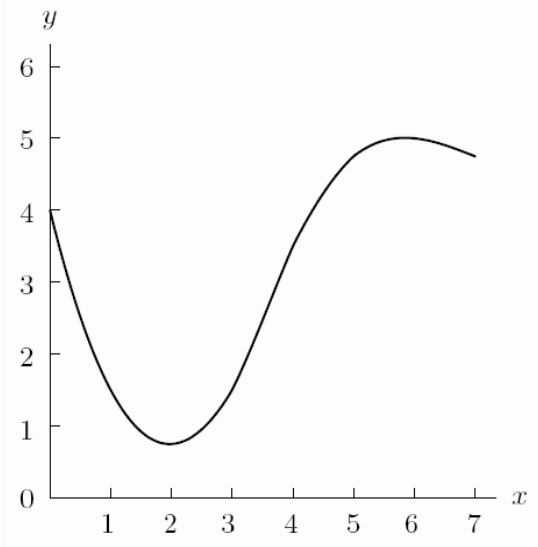
x	3	3.5	4	4.5	5	5.5	6
$f(x)$	17	27	34	38	41	43	44

Part A: A. positive
Part B: B. negative
Part C: C. 11
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2 review

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

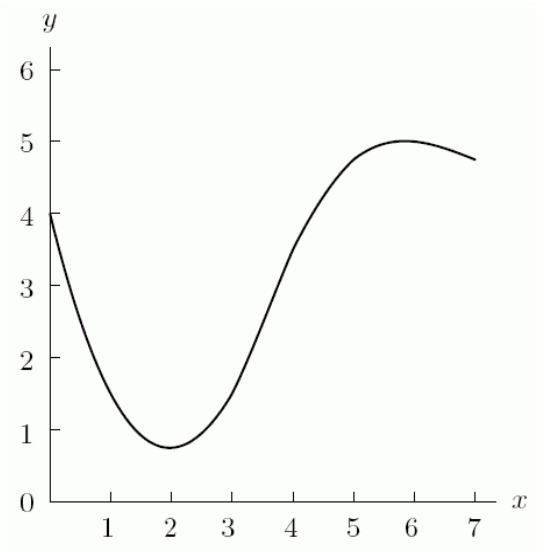
A. Is $f'(3)$ positive, negative, or zero?

B. Is $f''(3)$ positive, negative, or zero?



Part A: A. positive
Part B: B. positive
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: easy section: 2 review

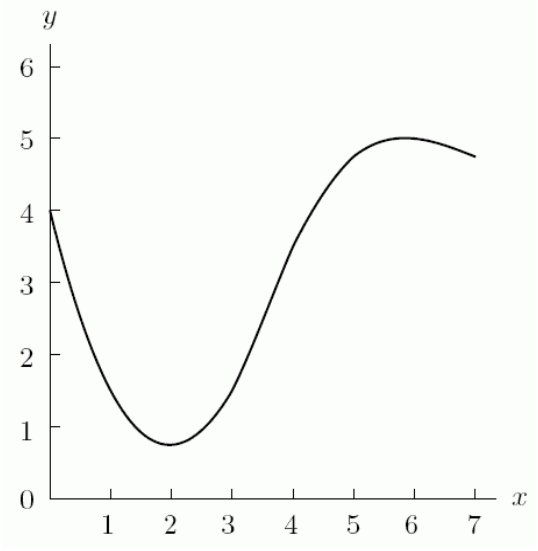
103. The function $y = f(x)$ is graphed below. Which is larger, $f'(5)$ or $f'(4)$?



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

Ans: B Learning Objectives: Estimate the derivative of a function given graphically. difficulty: easy section: 2 review

104. The function $y = f(x)$ is graphed below. Which is larger, $f''(3)$ or $f''(6)$?



A) $f''(3)$
B) $f''(6)$

Ans: A Learning Objectives: Understand what the second derivative conveys graphically. difficulty: easy section: 2 review

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

Ans: positive
Learning Objectives: Understand what the second derivative conveys graphically.
difficulty: medium section: 2 review

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 $f'(1950)$. 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) 2.14 million cars/year
B) 40.3 million cars/year
C) 44.6 million cars/year
D) 3.71 million cars/year
Ans: A Learning Objectives: Estimate the derivative of a function given graphically. difficulty: medium section: 2 review

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

Ans: –8
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: medium section: 2 review

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

Ans: 3
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: medium section: 2 review

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

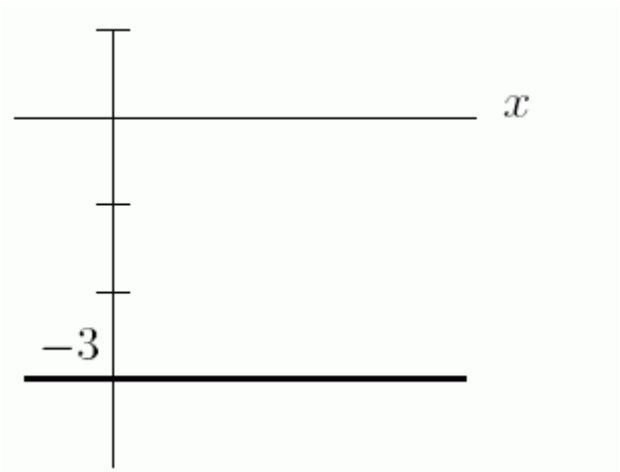
Ans: A Learning Objectives: Understand relative rate of change.
difficulty: hard section: 2 review

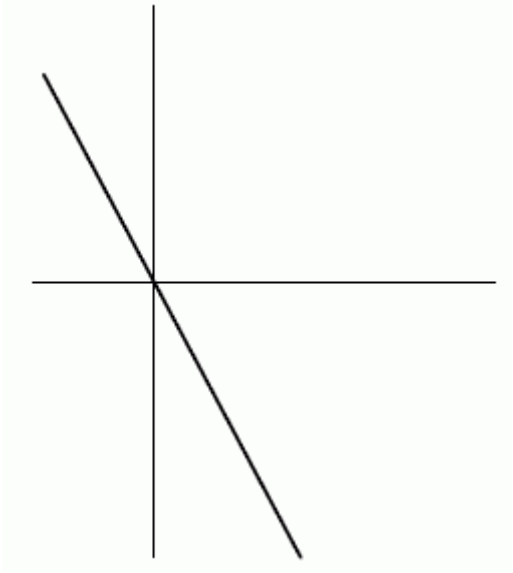
110. There is a population of $P(t)$ thousand bacteria in a culture at time *t* hours after the beginning of an experiment. You know that $P(10) = 25$, $P'(10) = 0.3$, and $P''(10) = 0.008$. Using these values, make a prediction for $P'(10.5)$

A) 0.302
B) 0.304
C) 0.306
D) 0.308

Ans: B Learning Objectives: Understand relative rate of change.
difficulty: hard section: 2 review

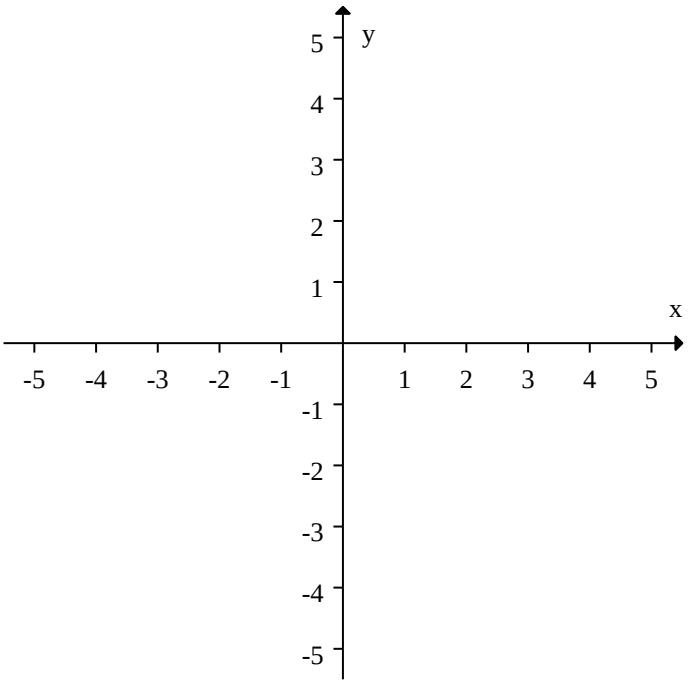
111. The first figure shows the graph of the derivative of a function. Could the second figure be the original function?



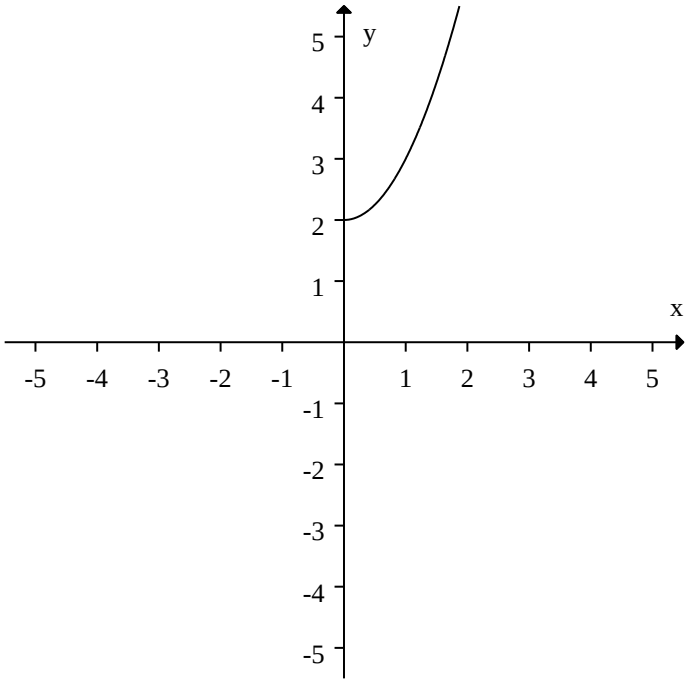


Ans: yes
Learning Objectives: Estimate the derivative of a function given graphically.
difficulty: easy section: 2 review

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

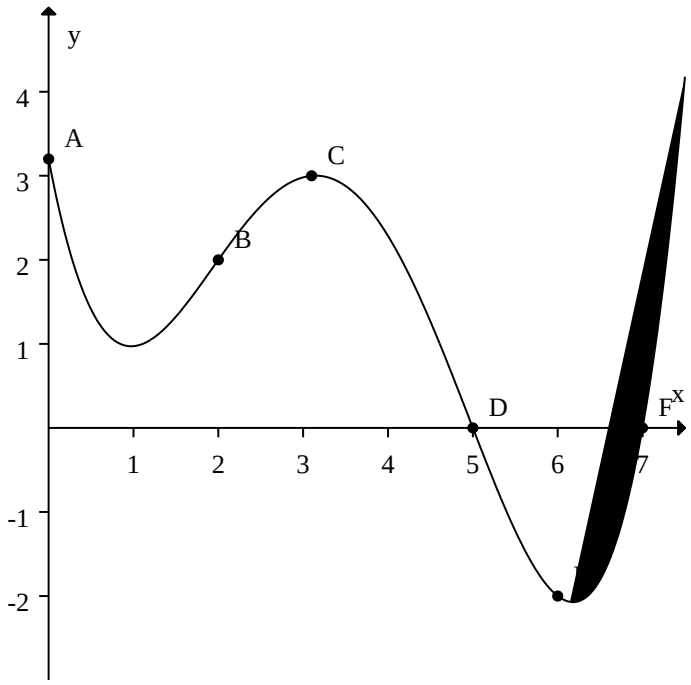


Ans:



Learning Objectives: Estimate the derivative of a function given graphically.; Understand what the second derivative conveys graphically. difficulty: hard
section: 2 review

113. Which point has a slope of –0.5 ?



Ans: E
Learning Objectives: Understand what the derivative conveys graphically.
difficulty: easy section: 2 review

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	1077	1396
Songs Purchased (in millions)	1	5	10	25	50	100	200	500	1000	2000

A) Estimate $S'(1396)$ with the appropriate units.
B) Use $S'(1396)$ to estimate $S(1600)$ to 2 decimal places.
Part A: $3.1348 \ \frac{\text{million songs}}{\text{day}}$
Part B: 2639.50 million songs
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: hard section: 2 review

115. There is a function used by statisticians, called the error function, which is written y=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.
Ans: 0.40
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2 review

116. Estimate the value of $f'(x)$ for the function $f(x) = 10^x$.

A) $2.303x(10)^{x-1}$

B) $x(10)^{x-1}$

C) $10(10)^x$

D) $2.303(10)^x$

Ans: D Learning Objectives: Estimate the derivative of a function given numerically. difficulty: medium section: 2 review

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.

A) True
B) False

Ans: B Learning Objectives: Understand what the derivative conveys graphically.
difficulty: medium section: 2 review

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.

A) True
B) False

Ans: A Learning Objectives: Understand what the second derivative conveys graphically. difficulty: medium section: 2 review

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*.

A) True
B) False
Ans: A Learning Objectives: Understand what the derivative conveys graphically.
difficulty: easy section: 2 review

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*.

A) True
B) False
Ans: A Learning Objectives: Understand instantaneous rate of change/derivative graphically. difficulty: easy section: 2 review

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 $\lim_{x \to +\infty} f(x) = -\infty$.

A) True
B) False
Ans: A Learning Objectives: Understand what the second derivative conveys graphically. difficulty: medium section: 2 review

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 $\lim_{x \to +\infty} f(x) = \infty$.

A) True
B) False
Ans: B Learning Objectives: Understand what the second derivative conveys graphically. difficulty: medium section: 2 review

123. Let $f(x) = x^2 + 4$. Derive an exact formula for the derivative function $f'(x)$ by computing algebraically the limit of a difference quotient.
Ans: $2x$
Learning Objectives: Use derivatives to estimate the value of a function.
difficulty: easy section: 2 review

124. Let $f(x) = x^2 + 2$. Write an equation for the line tangent to the graph of $f(x) = x^2 + 2$ at the point where $x = 4$.
Ans: $y = 8x - 14$
Learning Objectives: Understand instantaneous rate of change/derivative graphically.
difficulty: hard section: 2 review

125. Approximate to 3 decimal places (with a difference quotient and a calculator) the derivative of $\sqrt{2x+1}$ at $x = 1$.
Ans: 0.577
Learning Objectives: Understand relative rate of change. difficulty: medium
section: 2 review

126. Find $f'(x)$ algebraically by using the limit definition if $f(x) = \dfrac{1}{x+2}$.
A) $\dfrac{1}{(x+2)^2}$
B) $\dfrac{-1}{(x+2)^2}$
C) $\dfrac{1}{x+2}$
D) 1
Ans: B Learning Objectives: Use derivatives to estimate the value of a function.
difficulty: hard section: 2 review

127. Using a calculator, estimate the derivative of $f(x) = \cos(x)$ at $x = 0$. Make sure your calculator is set to radians.
Ans: 0
Learning Objectives: Understand relative rate of change. difficulty: easy
section: 2 review

128. Using a calculator, estimate the derivative of $f(x) = \sin(x)$ at $x = \pi$. Make sure your calculator is set to radians.
Ans: –1
Learning Objectives: Understand relative rate of change. difficulty: easy
section: 2 review

129. Give the difference quotient approximation to 2 decimal places of $f'(4)$ where $f(x) = \sqrt{x^3 + 5}$.
Ans: 2.89
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2 review

130. A. Give a difference quotient approximation (to one decimal place) of $f'(3)$ where $f(x) = \sqrt{x^2 + 16}$.

B. Find the equation of the line tangent to the graph of $f(x)$ at the point where $x = 3$.
Part A: A. 0.6
Part B: B. $y = 0.6x + 3.2$
Learning Objectives: Estimate the derivative of a function given numerically.
difficulty: medium section: 2 review

131. Find the derivative of $g(x) = 3x^2 + 2x - 4$ at $x = 3$ algebraically.
Ans: 20
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2 review

132. Find the derivative of $m(x) = 2x^3$ at $x = 2$ algebraically.
Ans: 24
Learning Objectives: Understand instantaneous rate of change/derivative numerically.
difficulty: easy section: 2 review