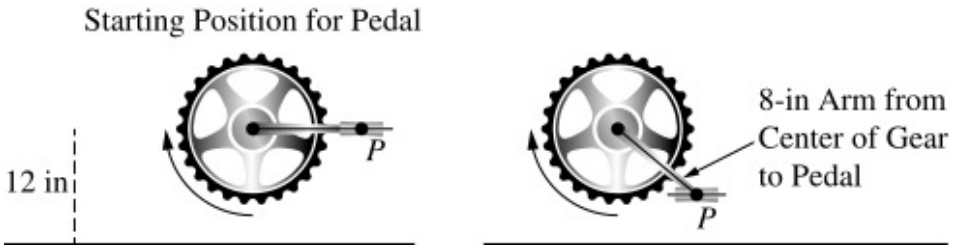
MCQ_Review_Calc

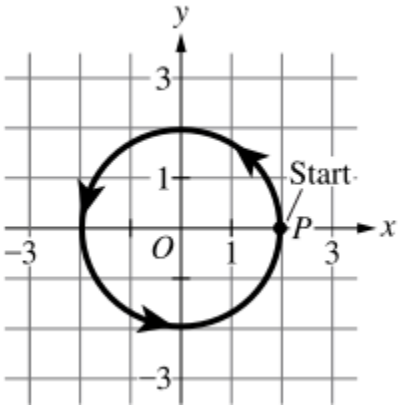
1.



A physical therapy center has a bicycle that patients use for exercise. The height, in inches (in), of the bicycle pedal above level ground periodically increases and decreases when used. The figure gives the position of the pedal P at a height of 12 inches above the ground at time $t = 0$ seconds. The pedal's 8-inch arm defines the circular motion of the pedal. If a patient pedals 1 revolution per second, which of the following could be an expression for $h(t)$, the height, in inches, of the bicycle pedal above level ground at time t seconds?

(A) $8 - 12\sin t$
(B) $12 - 8\sin t$
(C) $8 - 12\sin(2\pi t)$
(D) $12 - 8\sin(2\pi t)$

2.

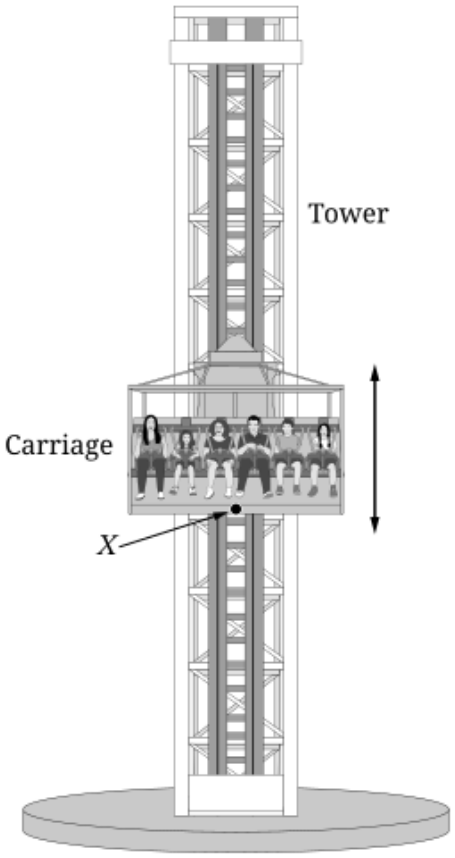


A large wheel of radius 2 feet is rotated at a constant rate. The figure provides a representation of the wheel in the xy-plane with the direction of rotation indicated. At time $t = 0$ minutes, the wheel begins to rotate. Point P on the wheel is at the "Start" position in the figure. At time $t = 20$ minutes, 120 rotations of the wheel have been completed, and P is in the same position as it was at time $t = 0$. A sinusoidal function is used to model the y -coordinate of the position of P as a function of time t in minutes. Which of the following functions is an appropriate model for this situation?

(A) $f(t) = 2\sin\left(\frac{\pi}{10}t\right)$
(B) $f(t) = 2\sin\left(\frac{\pi}{3}t\right)$
(C) $f(t) = 2\sin(6t)$
(D) $f(t) = 2\sin(12\pi t)$

MCQ_Review_Calc

3.



Note: Figure not drawn to scale.

A theme park thrill ride involves a tower and a carriage that rapidly moves passengers up and down along a vertical axis, as shown in the figure. The carriage is lifted to the top of the tower, then released to move down the tower. The ride involves 10 controlled bounces from the highest point to the lowest point, and back to the highest point. A point X is located on the bottom of the carriage. The height of X above the ground, in feet, can be modeled by a periodic function H. At time $t = 0$ seconds, X is at its highest point of 120 feet. The lowest point for X is at a height of 20 feet. The next time X is at its highest point is at time $t = 8$ seconds, which is the end of the first bounce. Which of the following can be an expression for $H(t)$, where t is the time in seconds?

(A) $H(t) = 50\sin\left(\frac{\pi}{4}t\right) + 70$

(B) $H(t) = 50\cos\left(\frac{\pi}{4}t\right) + 70$

(C) $H(t) = 50\sin\left(\frac{\pi}{8}t\right) + 70$

(D) $H(t) = 50\cos\left(\frac{\pi}{8}t\right) + 70$

4. The rational function r is given by $r(x) = \frac{x^3 - 4x + 3}{x^4 + 2x - 4}$. For what values of x does $r(x) = 0$?

(A) $x = -2.303$ and $x = 1.000$ only

(B) $x = -1.643$ and $x = 1.144$ only

(C) $x = -2.303$, $x = 1.000$, and $x = 1.303$ only

(D) $x = -2.303$, $x = -1.643$, $x = 1.000$, $x = 1.303$, and $x = 1.144$

MCQ_Review_Calc

5. The function f is given by $f(x) = \sin(2.25x + 0.2)$. The function g is given by $g(x) = f(x) + 0.5$. What are the zeros of g on the interval $0 \leq x \leq \pi$?

(A) 1.085 and 2.481

(B) 1.307 and 2.704

(C) 1.540 and 2.471

(D) 0.144, 1.075, and 2.936

6. The function f is given by $f(x) = 4 \cdot 3^{(x-2)} + 1$. The function g is given by $g(x) = f^{-1}(x)$. For which of the following values does $g(x) = -3x$?

(A) -0.426

(B) 1.016

(C) 1.025

(D) 1.444

7.

Day	0	5
Amount (grams)	2	6.315

The table gives values for the amount of a certain substance, in grams, on certain days. The data are modeled by an exponential function f given by $f(t) = 2e^{(r \cdot t)}$, where t is the number of days since day 0. The constant r is defined as the continuous growth rate of this model. Based on the table, what is the value of r ?

(A) 0.230

(B) 0.259

(C) 0.863

(D) 1.259

8. A certain type of machine produces a number of amps of electricity that follows a cyclic, periodically increasing and decreasing pattern. The machine produces a maximum of 7 amps at certain times and a minimum of 2 amps at other times. It takes about 5 minutes for one cycle from 7 amps to the next 7 amps to occur. Which of the following graphs models amps as a function of time, in minutes, for this machine?

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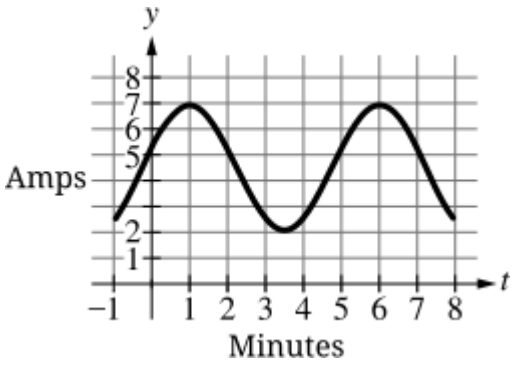
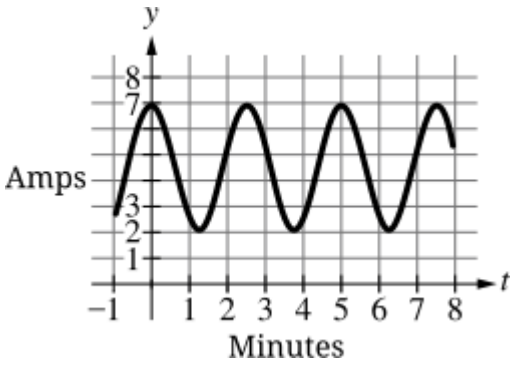
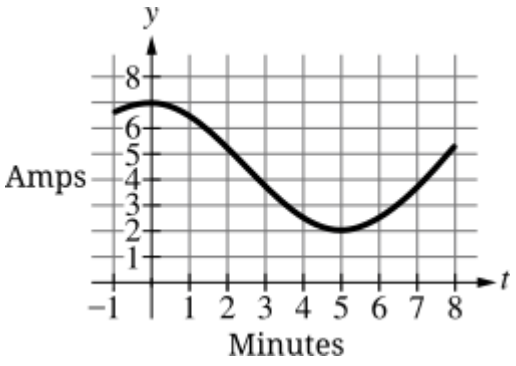
(A)



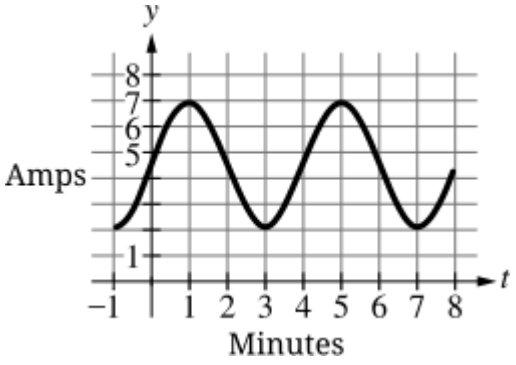
(B)



(C)



(D)



9. The fifth term of a geometric sequence is 24, and the sixth term is 48. What is the value of the tenth term?

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(A) 144
(B) 168
(C) 768
(D) 1536

10. The first term of an arithmetic sequence is 5, and the common difference of the sequence is 2. What is the eighth term of the sequence?

(A) 19
(B) 21
(C) 640
(D) 1280

11. The terms of the increasing arithmetic sequence a_n are positive. The terms of the increasing geometric sequence g_n are positive. The values of the first terms of both sequences are the same, and the values of the fourth terms of both sequences are the same. Which of the following statements describes the values of the second terms of the sequences?

(A) The second term of the arithmetic sequence must be less than the second term of the geometric sequence.
(B) The second term of the arithmetic sequence must be greater than the second term of the geometric sequence.
(C) The second term of the arithmetic sequence must be the same value as the second term of the geometric sequence.
(D) The relationship between the values of the second terms cannot be determined from the given information.

12. The function S is given by $S(t) = \frac{500{,}000}{1+0.4e^{kt}}$, where k is a constant. If $S(4) = 300{,}000$, what is the value of $S(12)$?

(A) 175,325
(B) 214,772
(C) 343,764
(D) 357,143

13.

t	1	2	3	4	5
$m(t)$	30	50	83	139	231

The table gives values for a function m at selected values of t. Which of the following graphs could represent these data in a semi-log plot, where the vertical axis is logarithmically scaled?

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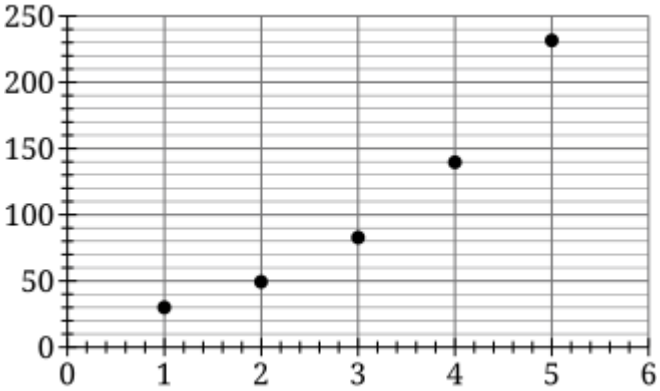
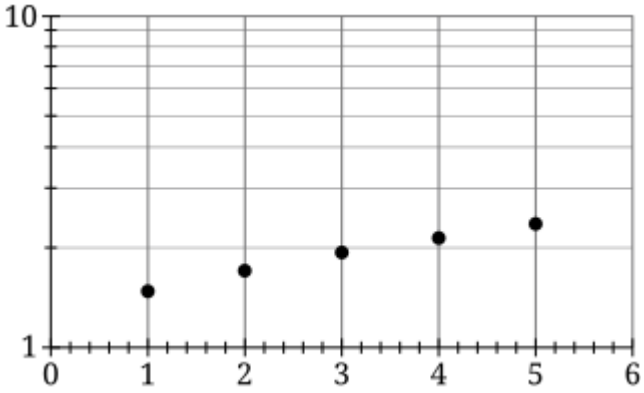
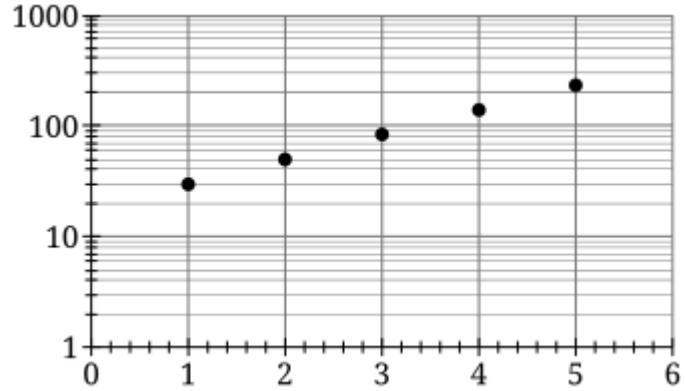
(A)



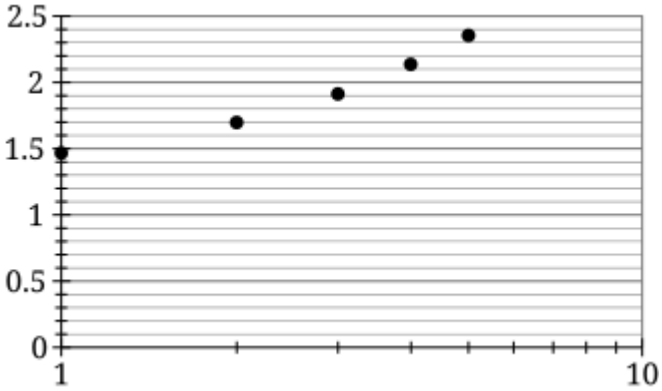
(B)



(C)



(D)



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14.

Time t (hours past 12 midnight)	Temperature ($^\circ$F)
0	91
6	83
11	92
18	102
23	92

The table gives the temperature, in degrees Fahrenheit, in a certain town on a given day at selected times t, in hours past 12 midnight. A sinusoidal regression model $y = a\sin(bt + c) + d$ is calculated using all five data points, where time t is the input value and temperature y is the output value. Based on the regression model, which of the following is the best choice for the amplitude of the sinusoidal function?

(A) 9.5
(B) 9.8
(C) 19.5
(D) 92.5

15.

x	-2	1	2	5
y	1	6	2	-3

The table gives values for the invertible function $y = f(x)$ for selected values of x. Which of the following input-output pairs describes f^{-1} ?

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(A)

Input values	-3	1	2	6
Output values	$\frac{1}{5}$	$-\frac{1}{2}$	$\frac{1}{2}$	1

(B)

Input values	-3	1	2	6
Output values	5	-2	2	1

(C)

Input values	-2	1	2	5
Output values	1	$\frac{1}{6}$	$\frac{1}{2}$	$-\frac{1}{3}$

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(D)

Input values	-2	1	2	5
Output values	1	6	2	-3

16.

Year	2002	2004	2005	2008	2011	2013	2014
Surcharge (dollars)	1.38	1.37	1.54	1.97	2.40	2.60	2.77

The table gives the average automated teller machine (ATM) surcharge fee, in dollars, in the United States for selected years from 2002 to 2014. An exponential regression $y = ab^t$ is used to model these data, where $t = 2$ corresponds to 2002. Based on the exponential model, what is the error in the model, in dollars, for 2013, and is the value predicted by the model for 2013 an underestimate or overestimate of the surcharge fee?

(A) The error is 0.01, and the value predicted by the model is an underestimate.

(B) The error is 0.01, and the value predicted by the model is an overestimate.

(C) The error is 0.03, and the value predicted by the model is an underestimate.

(D) The error is 0.03, and the value predicted by the model is an overestimate.

17. The speed of a car traveling on a highway is being recorded once per second for two minutes. During this time interval, the car gradually speeds up slightly to pass another vehicle, then the car returns to its original speed. The recorded speed of the car with respect to time can be modeled by linear, quadratic, and exponential functions. For each of the three models, their residuals are small and are without pattern. Which of the following conclusions is best?

(A) A linear model is best based on contextual clues.

(B) A quadratic model is best based on contextual clues.

(C) An exponential model is best based on contextual clues.

(D) Contextual clues fail to help in selecting a model for this contextual situation.

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18.

Year	US Federal Education Spending (billions of dollars)
2011	$112.8
2012	$109.3
2013	$105.1
2014	$104.5
2015	$99.0
2016	$99.3
2017	$97.7

The table gives amounts of United States federal education spending, in billions of dollars, for selected years. A linear regression is used to construct a function model S that models the spending, in billions of dollars, over the given years. If $t = 1$ corresponds to 2011, $t = 2$ corresponds to 2012, and this pattern continues, which of the following defines function S ?

(A) $S(t) = -2.55t + 114.157$

(B) $S(t) = -2.55t + 5239.657$

(C) $S(t) = -8.099t + 113.820$

(D) $S(t) = -0.369t + 42.308$

19. The function f is given by $f(x) = x^2 + 3x - 5$. Which of the following describes f ?

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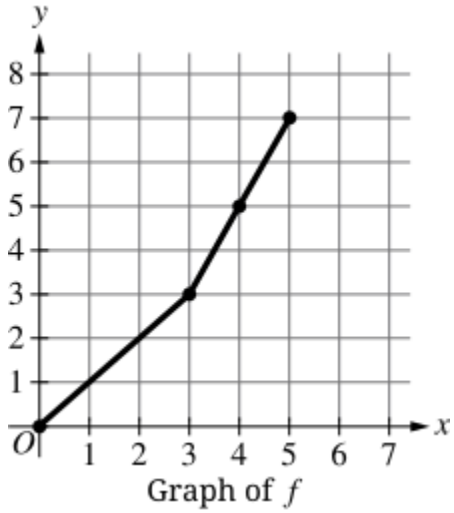
(A) For any interval of x, the function always has a positive rate of change.

(B) For any interval of x, the function always has a negative rate of change.

(C) For any interval of $x < -1.5$, the function has a positive rate of change, and for any interval of $x > -1.5$, the function has a negative rate of change.

(D) For any interval of $x < -1.5$, the function has a negative rate of change, and for any interval of $x > -1.5$, the function has a positive rate of change.

20.



Graph of f

The graph of the piecewise-linear function f is shown in the figure. Let g be the inverse function of f. What is the maximum value of g ?

(A) $\frac{1}{7}$

(B) $\frac{1}{5}$

(C) 5

(D) 7

21.

x	-2	-1	0	1	2
$f(x)$	1	2	-1	-2	0
$g(x)$	2	0	1	-1	0

The table gives values for the functions f and g at selected values of x. Functions f and g are defined for all real numbers. Let h be the function defined by $h(x) = f(g(x))$. What is the value of $h(0)$?

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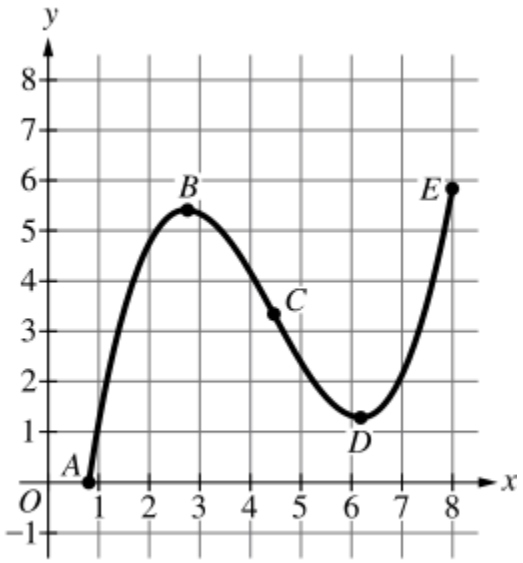
(A) -2
(B) -1
(C) 0
(D) 2

22.



Graph of f

The figure shows the graph of a function f. The zero and extrema for f are labeled, and the point of inflection of the graph of f is labeled. Let A, B, C, D, and E represent the x-coordinates at those points. Of the following, on which interval is f increasing and the graph of f concave down?

(A) the interval from A to B
(B) the interval from B to C
(C) the interval from C to D
(D) the interval from D to E

23. A ball is thrown through an open window to the ground below. The height of the ball, in meters, at time t seconds after it is thrown can be modeled by the function h, given by $h(t) = -4.9t^2 + 4.4t + 15.24$. Which of the following describes the height of the ball above the ground?

(A) The ball begins at its maximum height of 15.240 meters. The height of the ball decreases until it reaches the ground 1.820 seconds after it leaves the window.
(B) The ball begins at its maximum height of 15.240 meters. The height of the ball decreases until it reaches the ground 2.269 seconds after it leaves the window.
(C) After leaving the window, the height of the ball increases to its maximum height of 16.228 meters. Then the height of the ball decreases until it reaches the ground 1.820 seconds after reaching its maximum height.
(D) After leaving the window, the height of the ball increases to its maximum height of 16.228 meters. Then the height of the ball decreases until it reaches the ground 2.269 seconds after reaching its maximum height.

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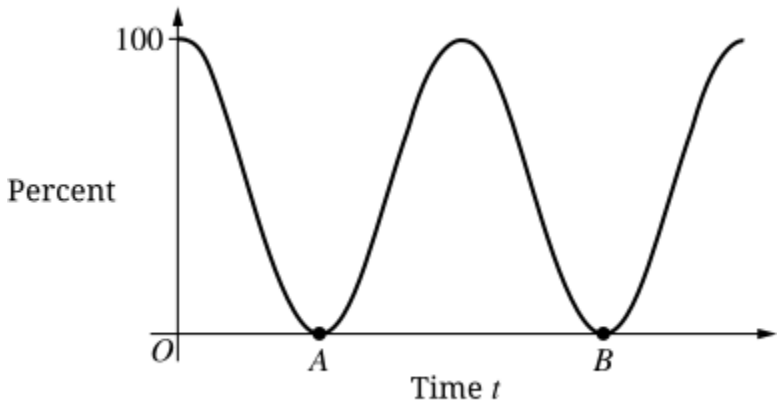
24.



New Moon	First Quarter	Full Moon	Third Quarter
May 4	May 10	May 18	May 26
June 2	June 9	June 16	June 25
July 1	July 8	July 16	July 24

When seen from Earth, the percent of the Moon illuminated by the Sun varies. At the full moon phase, 100% of the Moon is illuminated, while at the new moon phase 0% of the Moon is illuminated. The graph gives the percent of the Moon illuminated at time t, in days, since an initial day, along with two labeled points A and B. The table gives the dates of the four consecutive, periodic moon phases for three months of a certain year. Approximately how many days occur between points A and B ? (Note: Assume that a year has 365 days and consists of 12 months.)

(A) 7

(B) 14

(C) 28

(D) 56

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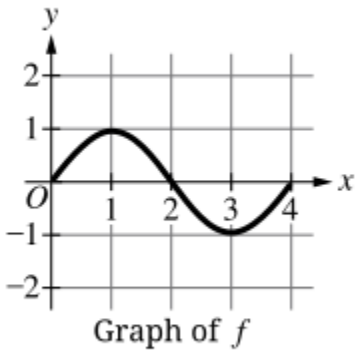
25.



Graph of f

The graph gives one cycle of a periodic function f in the xy-plane. Which of the following describes the behavior of f on the interval $39 < x < 41$?

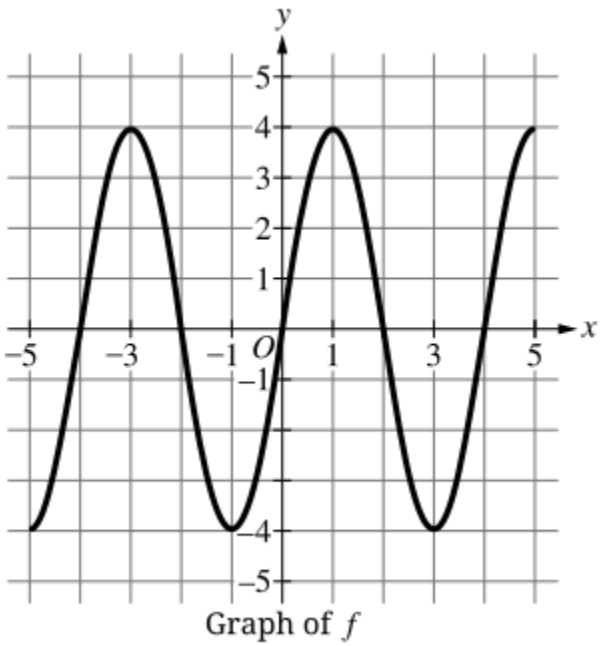
(A) The function f is decreasing.

(B) The function f is increasing.

(C) The function f is decreasing, then increasing.

(D) The function f is increasing, then decreasing.

26.



Graph of f

The graph of the function f is given in the xy-plane. Which of the following functions has the same period as f ?

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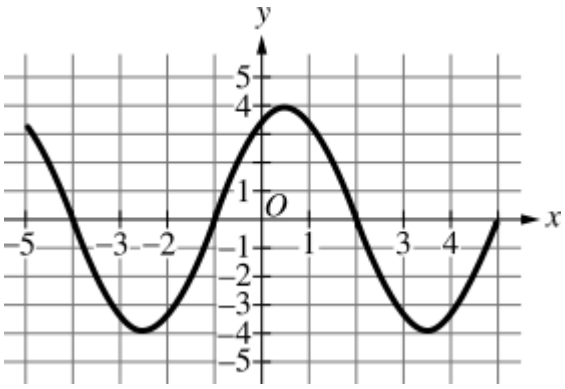
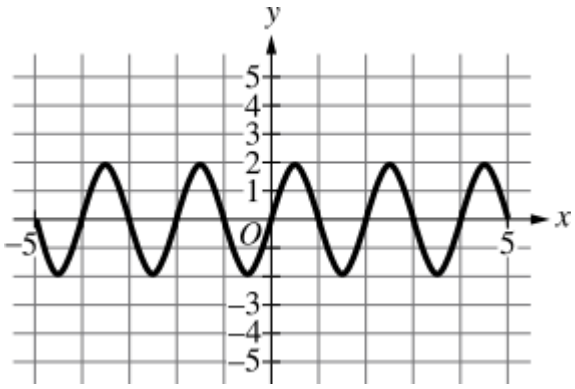
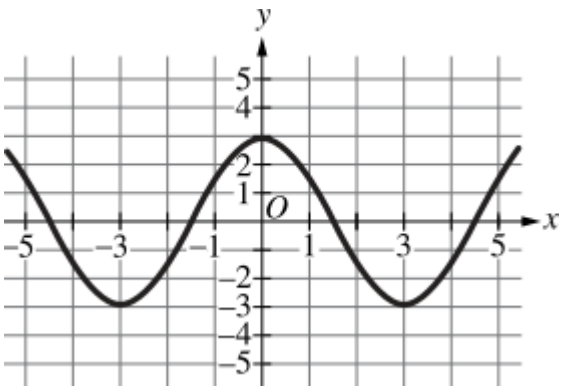
(A)



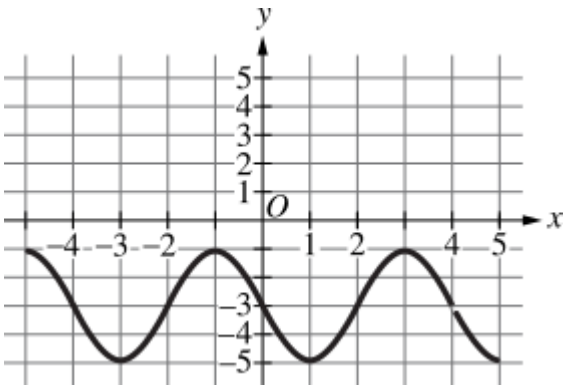
(B)



(C)



(D)



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27.

Pressure (P)	137.500	103.125	82.500	68.750	58.929	51.563	45.833	41.250
Volume (V)	12	16	20	24	28	32	36	40

Boyle's Law states that the pressure of a gas is inversely proportional to the volume of the gas at a constant temperature. The table gives the volume V, in milliliters (mL), of a gas for selected pressures P. Which of the following gives a model for the volume of the gas as a function of pressure? (Note: the units for pressure are not included.)

(A) $V(P) = 11.458P$

(B) $V(P) = 1650P$

(C) $V(P) = \frac{11.458}{P}$

(D) $V(P) = \frac{1650}{P}$

28.

Year	**Number of Vehicles (thousands)**
1996	265.0
1998	295.0
2000	394.7
2002	471.1
2004	565.5
2006	634.6
2008	775.7
2010	938.6

The table gives the number of alternative-fuel vehicles, in thousands, in use in the United States for selected years from 1996 to 2010. The function A defined by $A(t) = \frac{4615t - 8727}{-0.542t^2 + 15t + 1}$ is used to model the data, in thousands, for $6 \leq t \leq 20$, where $t = 6$ corresponds to 1996. Which of the following could be a plot of the residuals of the model?

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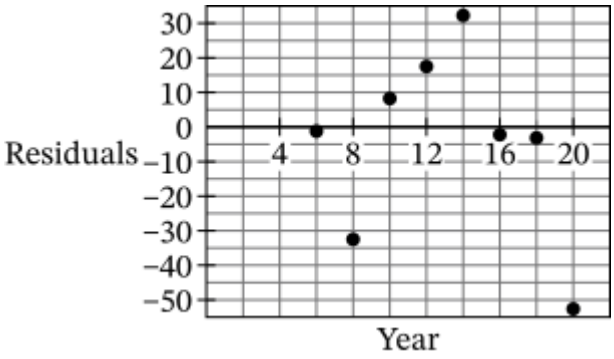
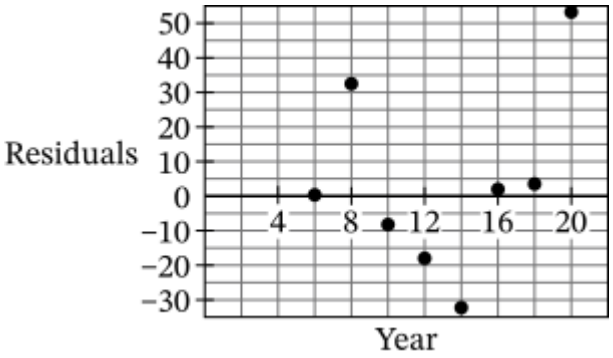
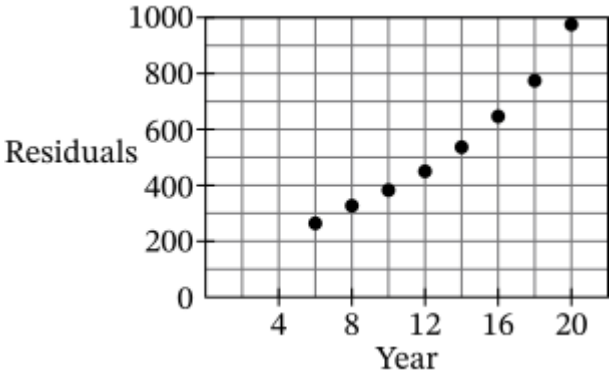
(A)



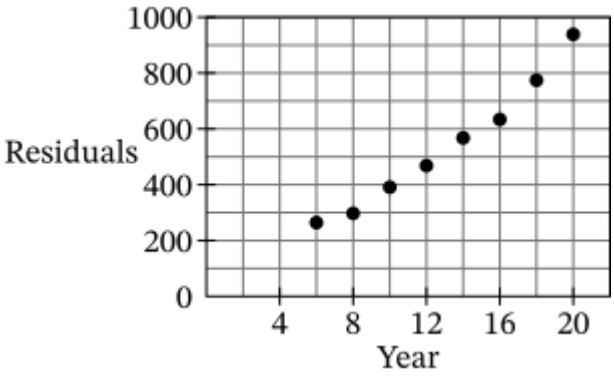
(B)



(C)

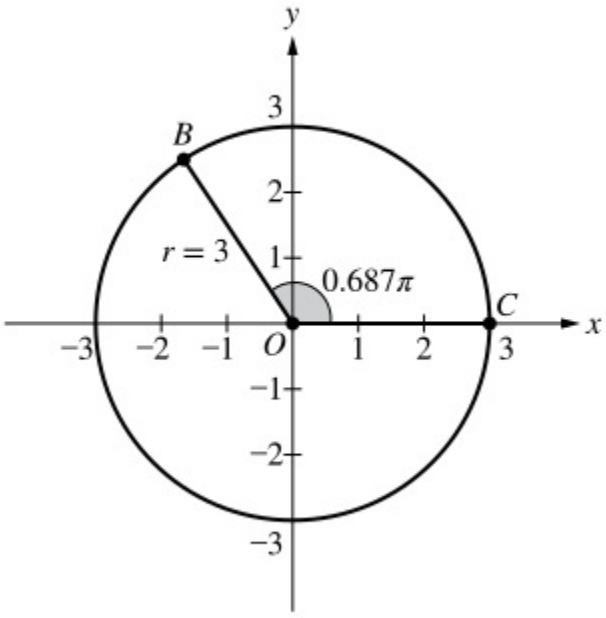


(D)



MCQ_Review_Calc

29.



The figure gives an angle in standard position with measure 0.687π and a circle with radius 3 in the xy-plane. What is the length of the minor arc of the circle from point C to point B, the arc subtended by the angle?

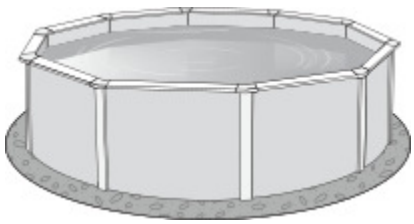
(A) 0.719

(B) 2.158

(C) 6.475

(D) 9.712

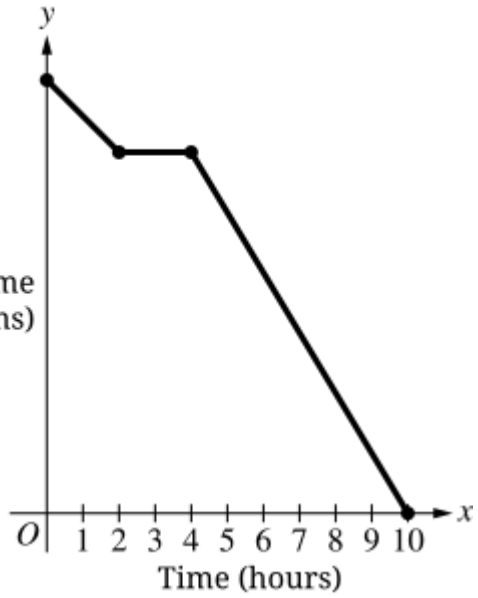
30.



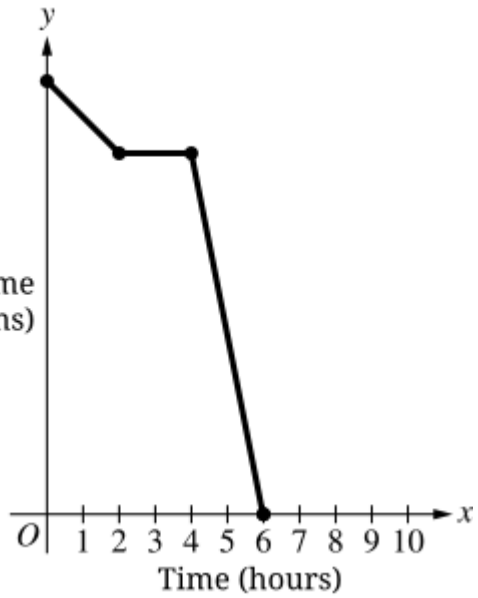
The figure shows a swimming pool filled with water. A pump is used to remove water from the pool until the pool is empty. When the pump is running, the rate at which the volume of water in the pool decreases is constant. During the first two hours, the pump works slower than usual due to a broken piece. Then the pump stops working. The broken piece is replaced, and the pump works at its usual rate until the pool is completely emptied of water. The entire process of emptying the pool takes six hours. Which of the following graphs could depict this situation, where time, in hours, is the independent variable, and the volume of water in the pool, in gallons, is the dependent variable?

MCQ_Review_Calc

(A)

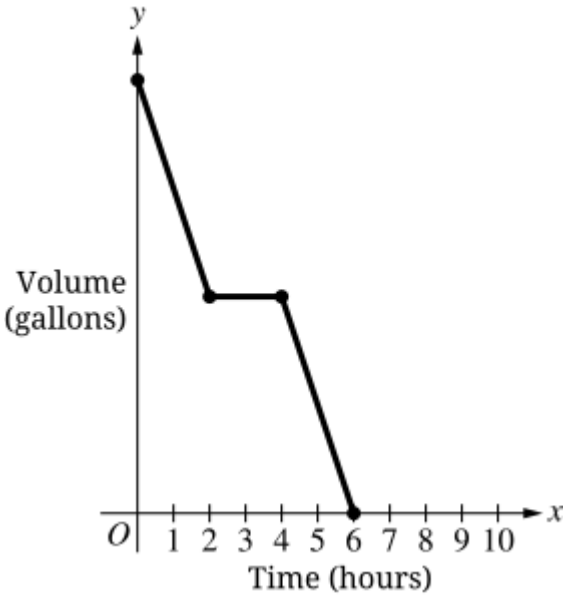


(B)

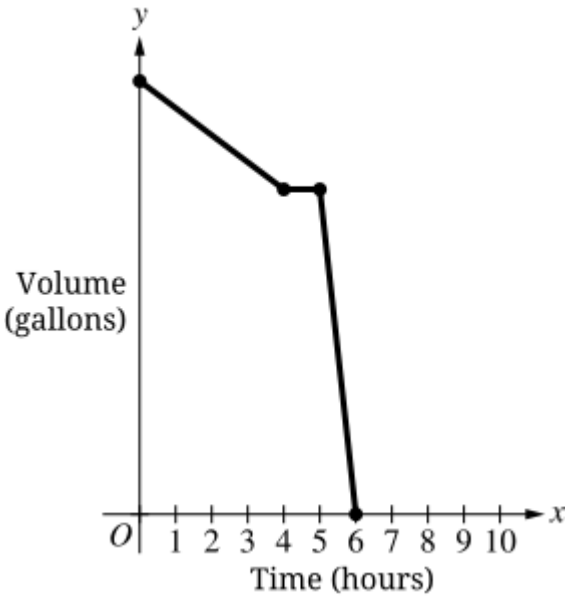


(C)

MCQ_Review_Calc



(D)

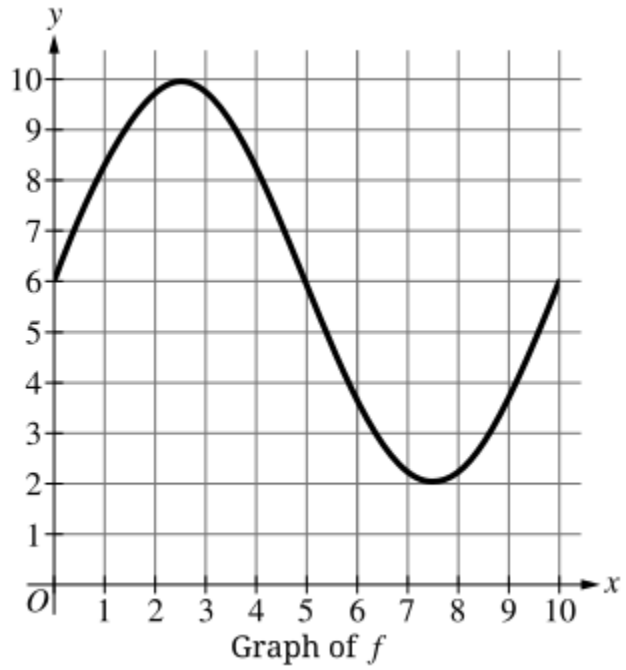


31. The Richter scale is a numerical scale that uses base 10 logarithms for measuring an earthquake's magnitude. The larger the number, the more intense the earthquake. For example, an earthquake with a magnitude of 5.0 is 10 times more intense than an earthquake with a magnitude of 4.0. Two well-known earthquakes occurred in the year 1906. The San Francisco earthquake had a magnitude of 7.9, and the Chile earthquake had a magnitude of 8.2. Approximately how many times more intense was the Chile earthquake than the San Francisco earthquake?

(A) 0.3
(B) 0.5
(C) 2.0
(D) 3.0

MCQ_Review_Calc

32.



Graph of f

The graph of the sinusoidal function f is given in the xy-plane. Of the following, which is greatest?

(A) The length of the interval that satisfies $f(x) \leq 5$

(B) The sum of the lengths of the intervals that satisfy $5 \leq f(x) \leq 6$

(C) The length of the interval that satisfies $f(x) \geq 9$

(D) The length of the interval that satisfies $f(x) \geq 10$

33. Consecutive terms of a sequence have the values 6, 2, -2, and -6. Of the following, which describes the sequence?

(A) The terms could be part of an arithmetic sequence with a common difference of -4.

(B) The terms could be part of a geometric sequence with a common difference of -4.

(C) The terms could be part of an arithmetic sequence with a common ratio of -4.

(D) The terms could be part of a geometric sequence with a common ratio of -4.

34. The daily high temperatures of a certain city over a period of time are modeled with a sinusoidal function in the xy -plane. The maximum daily high temperature is $80^{\circ}\mathrm{F}$, and the minimum daily high temperature is $55^{\circ}\mathrm{F}$. Based on these temperatures, which of the following is the best value for the amplitude of the sinusoidal function?

(A) 12.5

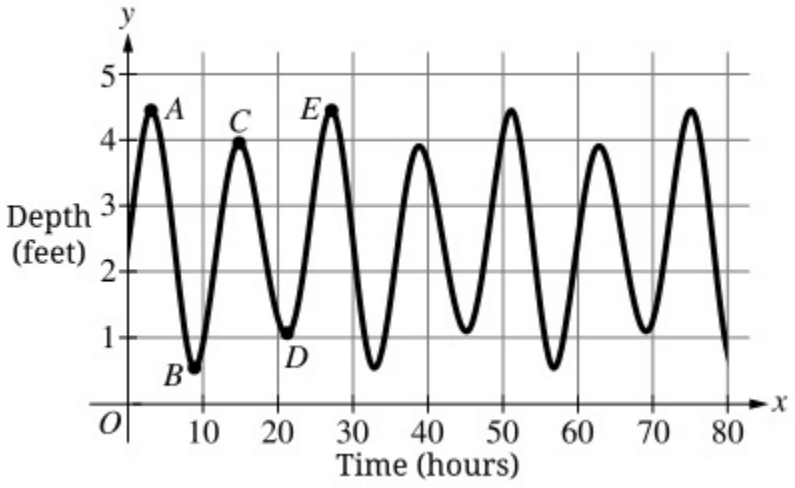
(B) 25

(C) 40

(D) 67.5

MCQ_Review_Calc

35.



A graph of the depth of water at a pier in the ocean is given, along with five labeled points A, B, C, D, and E in the xy-plane. For the time periods near these data points, a periodic relationship between depth of water, in feet, and time, in hours, can be modeled using one cycle of the periodic relationship. Based on the graph, which of the following is true?

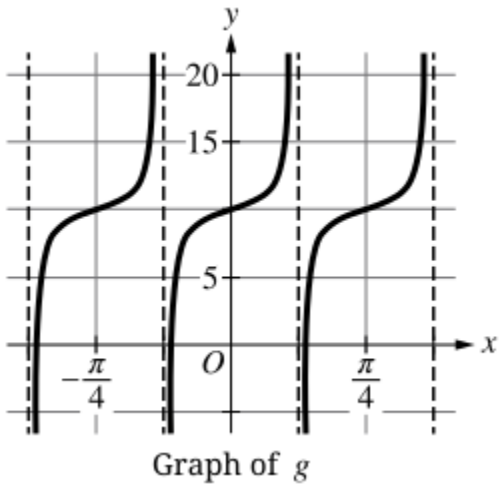
(A) The time interval between points A and B gives the period.

(B) The time interval between points A and C gives the period.

(C) The time interval between points A and D gives the period.

(D) The time interval between points A and E gives the period.

36.



The graph of the function g is given in the xy-plane. If g is the result of multiplicative and additive transformations of the graph of $y = \tan x$, what is the period of g ?

MCQ_Review_Calc

(A) $\frac{\pi}{8}$

(B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$

(D) π

37. A metronome is a practice tool that produces a steady beat to help musicians play rhythms accurately. Some metronomes use a pendulum that repeatedly swings left and right to produce the steady beat. Which of the following is true about the beat produced by the metronome and the motion of the pendulum?

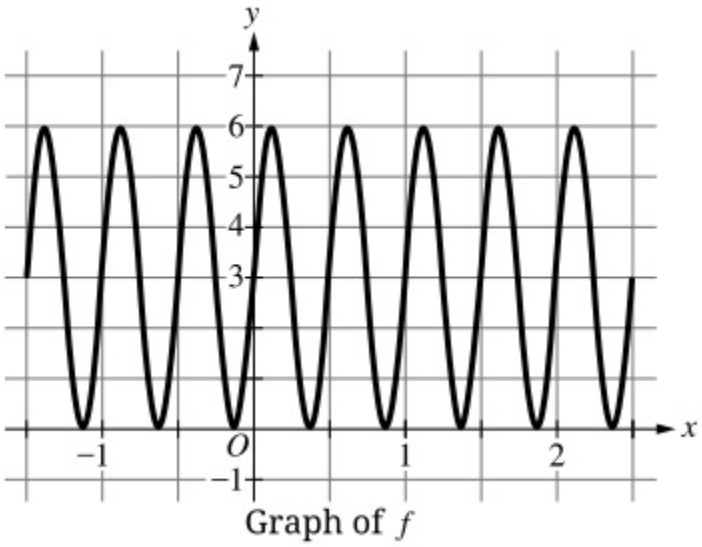
(A) Both the beat produced by the metronome and the motion of the pendulum have periodic relationships with time.

(B) Only the beat produced by the metronome has a periodic relationship with time.

(C) Only the motion of the pendulum has a periodic relationship with time.

(D) Neither the beat produced by the metronome nor the motion of the pendulum have periodic relationships with time.

38.



Graph of f

The figure shows the graph of a periodic function f in the xy-plane. What is the frequency of f ?

(A) 0.5

(B) 2

(C) 3

(D) 8

39. Consecutive terms of a sequence have the values 2, -1, $\frac{1}{2}$, $-\frac{1}{4}$, and $\frac{1}{8}$. Of the following, which describes the sequence?

MCQ_Review_Calc

(A) The terms could be part of a geometric sequence with a common ratio of -2.

(B) The terms could be part of a geometric sequence with a common ratio of $-\frac{1}{2}$.

(C) The terms could be part of a geometric sequence with a common ratio of $\frac{1}{2}$.

(D) The terms are part of a sequence other than a geometric sequence because the common ratio of a geometric sequence must be positive.

40. The number of hours of daylight per day in a certain town can be modeled by a sinusoidal function that is graphed in the xy-plane. Over the course of a year, the greatest number of hours of daylight per day is 14.5 hours, and the least number of hours of daylight per day is 7 hours. The line $y = d$, where d is a constant, is the midline of the graph of the sinusoidal function. Which of the following is the best value for d ? (Note: Assume that 1 year is 365 days.)

(A) 3.75

(B) 7.5

(C) 10.75

(D) 365

41.

θ	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$
$r = f(\theta)$	0	$\frac{5}{2}$	$\frac{5\sqrt{3}}{2}$

The table gives values of a polar function $r = f(\theta)$ for selected values of θ. If the value of $r = f\left(\frac{\pi}{12}\right)$ is estimated using the average rate of change of the function over the interval $0 \le \theta \le \frac{\pi}{6}$, which of the following is true?

(A) The estimated value would be an overestimate of the actual value by approximately 0.223.

(B) The estimated value would be an underestimate of the actual value by approximately 0.223.

(C) The estimated value would be an overestimate of the actual value by approximately 0.335.

(D) The estimated value would be an underestimate of the actual value by approximately 0.335.

42. At a coastal city, the height of the tide, in feet (ft), is modeled by the function h, defined by $h(t) = 6.3\cos\left(\frac{\pi}{6}t\right) + 7.5$ for $0 \le t \le 12$ hours. Based on the model, which of the following is true?

(A) The maximum height of the tide is 13.8 ft.

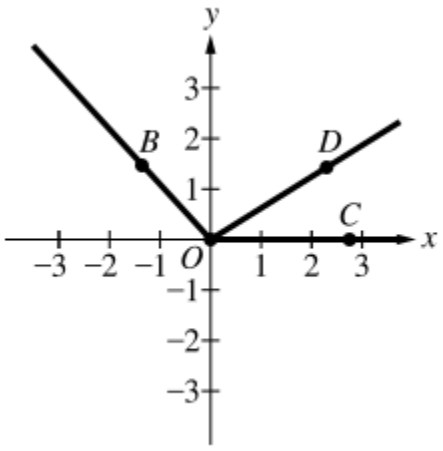
(B) The maximum height of the tide occurs at $t = 6$ hours.

(C) The minimum height of the tide is 1 ft.

(D) The minimum height of the tide occurs at $t = 12$ hours.

MCQ_Review_Calc

43.



The figure gives four points and some corresponding rays in the xy-plane. Which of the following is true?

(A) Angle COB is in standard position with initial ray OB and terminal ray OC.

(B) Angle COB is in standard position with initial ray OC and terminal ray OB.

(C) Angle DOB is in standard position with initial ray OB and terminal ray OD.

(D) Angle DOB is in standard position with initial ray OD and terminal ray OB.

MCQ_Review_Calc

44.

Month (x)	Debt (y) (dollars)
1	620
4	1,083
5	1,215
7	1,902

The table gives the amount of debt, in dollars, on an individual's credit card for certain months after opening the credit card. Using an exponential regression $y = ab^x$ to model these data, what is the debt at month 24 predicted by the exponential function model, to the nearest dollar? (Assume that the debt continues and that no payments are made to reduce the debt.)

(A) $5{,}267$
(B) $15{,}187$
(C) $42{,}159$
(D) $1{,}972{,}745$

45. The temperature, in degrees Celsius ($^\circ\text{C}$), in a city on a particular day is modeled by the function T defined by $T(t) = \frac{75t^3 - 836t^2 + 3100t - 4185}{14t^2 + 10t - 35}$, where t is measured in hours from 12 p.m. for $2 \le t \le 9$. Based on the model, how many hours did it take for the temperature to increase from 0°C to 5°C?

(A) 7.701
(B) 5.420
(C) 4.114
(D) 2.280

MCQ_Review_Calc

46. The amount of a certain medicine, in milligrams, in a patient's body t hours after an initial dose can be modeled by the exponential decay function f given by $f(t) = ab^t$. An initial dose of the medicine is 10 milligrams, and after 2 hours the amount in the body is 5 milligrams. At what time t will the amount in the body be 0.01 milligram? (Assume no additional doses of the medicine are given after the initial dose.)

(A) 3.996

(B) 4.983

(C) 9.966

(D) 19.932

47.

Time t (hours)	1	2	3
Mold (square micrometers)	0.3	0.75	1.875

The table gives the amount of mold, in square micrometers, on a certain food at time t hours. If the amount of mold grows exponentially, what would the amount of mold be, in square micrometers, at time $t = 3.75$?

(A) 1.538

(B) 3.728

(C) 4.688

(D) 9.320

48. Two function models k and m are constructed to represent the sales of a product at a group of grocery stores. Both $k(t)$ and $m(t)$ represent the sales of the product, in thousands of units, after t weeks for $t \geq 2$. If $k(t) = 14 - 2.885 \ln t$ and $m(t) = -t + 14$, what is the first time t that sales predicted by the logarithmic model will be 0.1 thousand units more than sales predicted by the linear model?

(A) $t = 6.318$

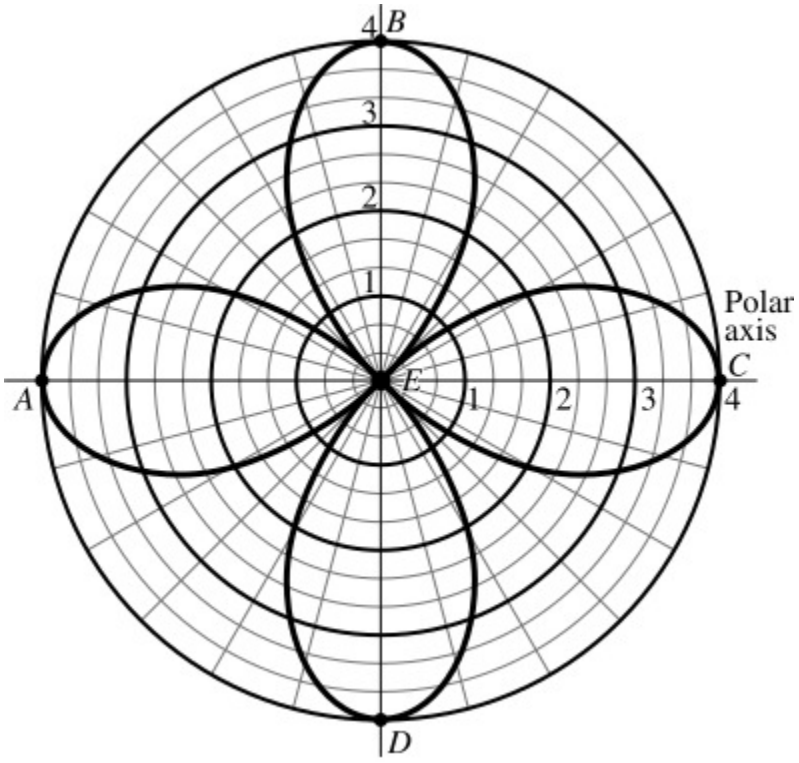
(B) $t = 4.324$

(C) $t = 3.577$

(D) $t = 2.289$

MCQ_Review_Calc

49.



The figure shows the graph of the polar function $r = f(\theta)$, where $f(\theta) = 4\cos(2\theta)$, in the polar coordinate system for $0 \leq \theta \leq 2\pi$. There are five points labeled A, B, C, D, and E. If the domain of f is restricted to $0 \leq \theta \leq \frac{\pi}{2}$, the portion of the given graph that remains consists of two pieces. One of those pieces is the portion of the graph in Quadrant I from C to E. Which of the following describes the other remaining piece?

(A) The portion of the graph in Quadrant I from E to B

(B) The portion of the graph in Quadrant II from E to A

(C) The portion of the graph in Quadrant III from E to A

(D) The portion of the graph in Quadrant III from E to D

50. In a certain simulation, the population of a bacteria colony can be modeled using a geometric sequence, where the first day of the simulation is day 1. The population on day 4 was $4{,}000$ bacteria, and the population on day 8 was $49{,}000$ bacteria. What was the population of the colony on day 6 based on the simulation?

(A) $26{,}500$

(B) $26{,}192$

(C) $14{,}000$

(D) 611

MCQ_Review_Calc

51.

Age of Tree (years)	Height of Tree (feet)
1	4.0
3	7.8
5	9.6
7	10.8
9	11.6
11	12.3
13	12.9

The table gives the height of a tree, in feet, for selected ages of the tree, in years. A logarithmic regression is used to produce a model of the form $f(x) = a + b \ln x$, where $f(x)$ gives the predicted height of a tree, in feet, at age x years. Based on the model, what is the predicted height of the tree, in feet, at age 10 years?

(A) 11.877
(B) 11.889
(C) 11.990
(D) 12.341

52. The life expectancy for a human in the United States can be modeled by the function L given by $L(x) = 42.53 + 13.86 \ln x$. $L(x)$ gives the life expectancy, in years, for x decades after the year 1900. Based on the model, when is the first time that human life expectancy is predicted to be 80 years? (Note: 1 decade is 10 years).

MCQ_Review_Calc

(A) Late 1914
(B) Early 2003
(C) Late 2040s
(D) Early 2050s

53. The Richter scale is a numerical scale that uses base 10 logarithms for measuring an earthquake's magnitude. The larger the number, the more intense the earthquake. As intensities increase multiplicatively by a factor of 10, the Richter scale increases additively by 1. Consider two earthquakes that occurred in the year 2022. An earthquake in Indonesia had a magnitude of 5.1, and an earthquake in Mexico had a magnitude of 2.5. Approximately how many times more intense was the Indonesia earthquake than the Mexico earthquake?

(A) 2.6
(B) 26
(C) 100
(D) 400

MCQ_Review_Calc

54.

Year	Life Expectancy (years)
2000	76.75
2004	77.38
2008	78.19
2012	78.79
2016	78.86
2019	78.87

The table gives values of average life expectancy, in years, for a child born in a given year in the United States. A linear regression is used to construct a linear function model L, where t represents the birth year, $t = 0$ is the year 2000, and $L(t)$ represents the life expectancy in years. For what year does the model predict that the life expectancy of a child born in that year will be 83 years?

(A) 2032

(B) 2051

(C) 2056

(D) 2086

55. The electromagnetic force between two particular particles is related to the distance between the particles. This relationship is modeled by the function F, where $F(d) = \frac{3.6}{d^2}$ for distance d, measured in centimeters, and force $F(d)$, measured in Newtons. What is the average rate of change, in Newtons per centimeter, in the electromagnetic force if the distance between two particles is increased from 2.3 centimeters to 3.1 centimeters?

MCQ_Review_Calc

(A) -0.382
(B) -0.306
(C) 0.375
(D) 5.625

56. An X-ray machine is used to eliminate germs in certain food processes. The intensity I, in millirads per hour, of X-rays produced by the machine is inversely proportional to the square of the distance d, in meters, from the machine. For a certain machine, the intensity is 26.5 millirads per hour at a distance of 4 meters. Based on this information and using the same machine, what is the intensity, in millirads per hour, at a distance of 3.3 meters?

(A) 18.037
(B) 29.176
(C) 32.121
(D) 38.935

57. The rate of people entering a subway car on a particular day is modeled by the function R, where $R(t) = 0.03t^3 - 0.846t^2 + 6.587t + 1.428$ for $0 \leq t \leq 20$. $R(t)$ is measured in people per hour, and t is measured in hours since the subway began service for the day. Based on the model, at what value of t does the rate of people entering the subway car change from increasing to decreasing?

(A) $t = 20$
(B) $t = 17.056$
(C) $t = 13.295$
(D) $t = 5.505$

58. For an arithmetic sequence S_n, $S_3 = 3$ and $S_6 = 24$. What is the value of $S_{10} - S_8$?

(A) 2
(B) 7
(C) 14
(D) 288

59. When a certain car is initially purchased, its value is $20{,}000$ dollars. If the car loses 9% of its value each year, when will the car's value be $10{,}000$ dollars?

(A) Between the date of the initial purchase and 1 year
(B) Between 1 year and 2 years after its initial purchase
(C) Between 5 years and 6 years after its initial purchase
(D) Between 7 years and 8 years after its initial purchase

60. The function f is defined by $f(x) = a\sin(b(x + c)) + d$, for constants a, b, c, and d. In the xy-plane, the points $(2,2)$ and $(4,4)$ represent a minimum value and a maximum value, respectively, on the graph of f. What are the values of a and d ?

MCQ_Review_Calc

(A) $a = 1$ and $d = 3$
(B) $a = 1$ and $d = 2$
(C) $a = 2$ and $d = 3$
(D) $a = 2$ and $d = 2$

61.

x	$f(x)$
-2	10
-1	15
1	40
2	56

The table presents values for a function f at selected values of x. An exponential regression $y = ab^x$ is used to model these data. What is the value of $f(1.5)$ predicted by the exponential function model?

(A) 46.767
(B) 47.342
(C) 47.800
(D) 47.917

62. The number of minutes of daylight per day for a certain city can be modeled by the function D given by $D(t) = 160\cos\left(\frac{2\pi}{365}(t - 172)\right) + 729$, where t is the day of the year for $1 \le t \le 365$. Which of the following best describes the behavior of $D(t)$ on day 150 ?

(A) The number of minutes of daylight per day is increasing at a decreasing rate.
(B) The number of minutes of daylight per day is decreasing at a decreasing rate.
(C) The number of minutes of daylight per day is increasing at an increasing rate.
(D) The number of minutes of daylight per day is decreasing at an increasing rate.

63. The function f is defined by $f(t) = 70 + 5\sin\left(\frac{2\pi}{365}(t - 90)\right)$ for $0 \le t \le 365$. Function f models the temperature of water in a lake, in degrees Fahrenheit, t days since January 1. Based on the model, the predicted temperature of the water will be greater than 72 degrees Fahrenheit for approximately how many days?

MCQ_Review_Calc

(A) 113
(B) 134
(C) 231
(D) 248

64. The function f is given by $f(x) = 2\sin(4x) + \cos(2x)$. Using the period of f, which of the following is the number of complete cycles of the graph of f in the xy-plane on the interval $0 \leq x \leq 1000$?

(A) 159
(B) 318
(C) 602
(D) 636

65. An open-top box is constructed by cutting squares that are x inches by x inches from the corners of an 11.2 -inch by 13.3-inch rectangular piece of cardboard, and then folding the sides of the box up to make walls. The volume of the box is modeled by the function V given by $V(x) = 4x^3 - 49x^2 + 148.96x$. Which of the following statements is true about the function V ?

(A) The contextual situation restricts the domain of V to $0 < x < 13.3$, and the relative maximum value of V on this domain is 2724.106. This is because the longer side of the cardboard determines the domain restriction.

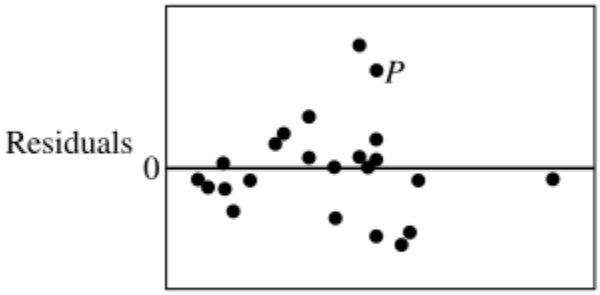
(B) The contextual situation restricts the domain of V to $0 < x < 11.2$, and the relative maximum value of V on this domain is 1141.504. This is because the shorter side of the cardboard determines the domain restriction.

(C) The contextual situation restricts the domain of V to $0 < x < 6.65$, and the relative maximum value of V on this domain is 133.929. This is because half of the longer side of the cardboard determines the domain restriction.

(D) The contextual situation restricts the domain of V to $0 < x < 5.6$, and the relative maximum value of V on this domain is 133.929. This is because half of the shorter side of the cardboard determines the domain restriction.

MCQ_Review_Calc

66.



The students in a precalculus class measured each student's height and arm span, in centimeters. The students calculated a linear regression $y = a + bx$ with heights as the input values and arm spans as the output values. The given residual plot has a point labeled P at coordinates $(175, 23.4)$. What does point P indicate in the context?

(A) Because point P is above the x-axis, for the student with a height of 175 cm, the model overestimates the actual arm span value by 23.4 cm.

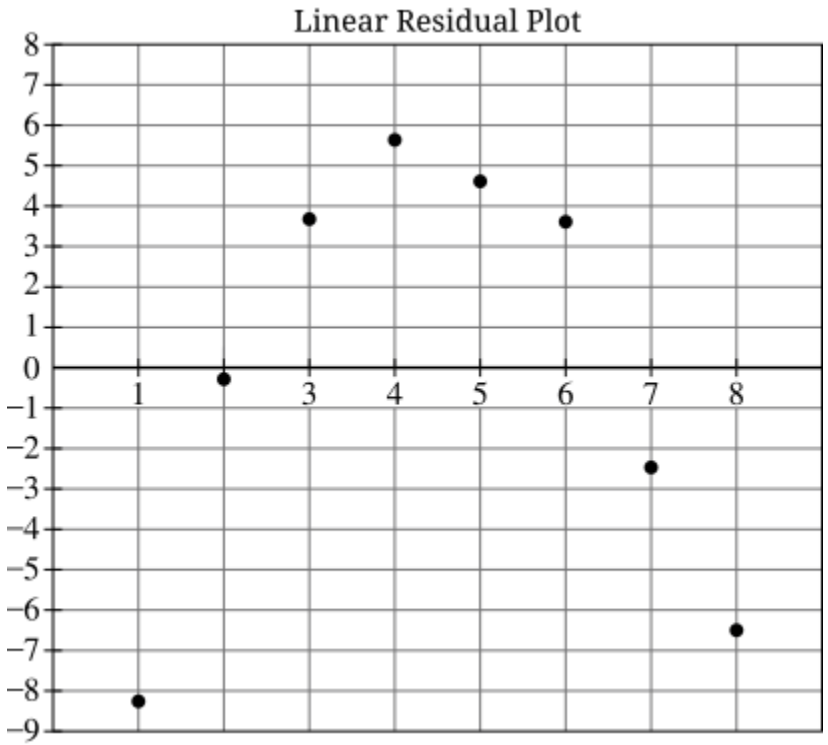
(B) Because point P is above the x-axis, for the student with a height of 175 cm, the model underestimates the actual arm span value by 23.4 cm.

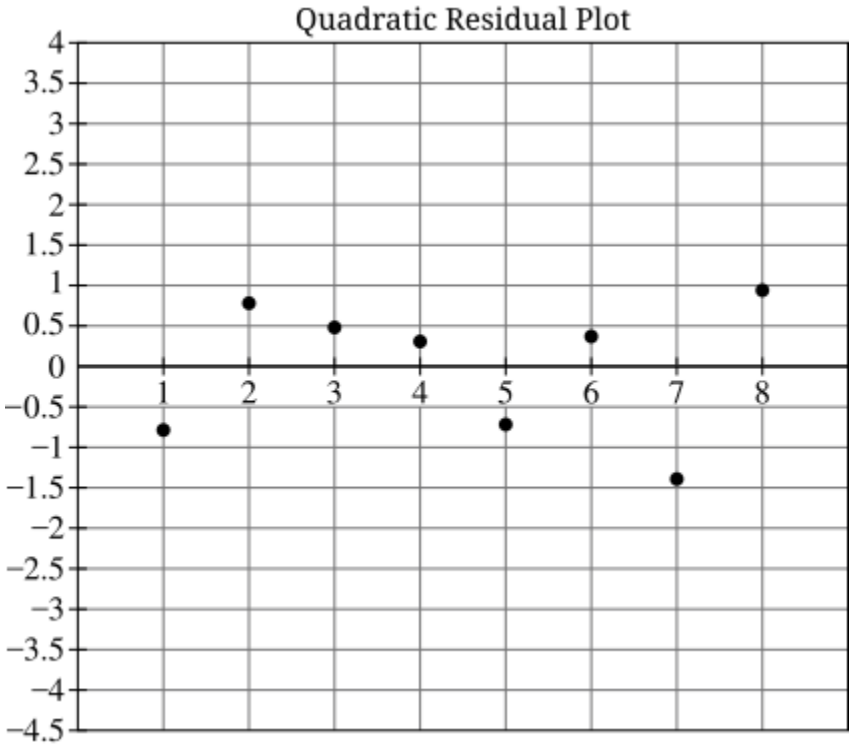
(C) Because point P is above the x-axis, for the student with an arm span of 175 cm, the model overestimates the actual height value by 23.4 cm.

(D) Because point P is above the x-axis, for the student with an arm span of 175 cm, the model underestimates the actual height value by 23.4 cm.

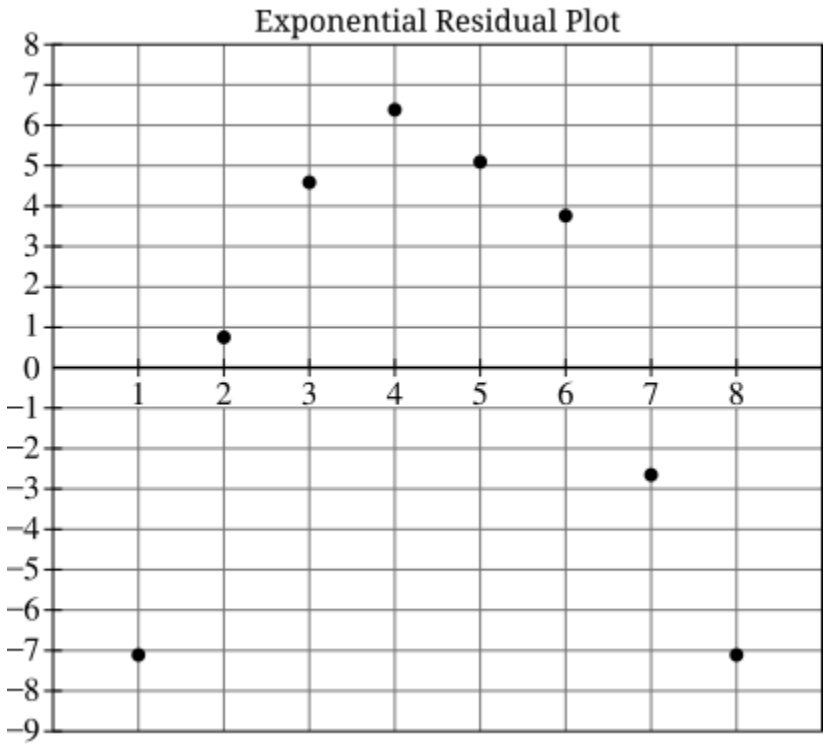
MCQ_Review_Calc

67.





MCQ_Review_Calc



The graphs give three residual plots for linear, quadratic, and exponential regressions. Which of the following is true about the residual plots for these regressions?

(A) The residual plots for the linear and exponential regressions are without pattern, and the residual plot for the quadratic regression shows a pattern. Therefore, the quadratic model is appropriate.

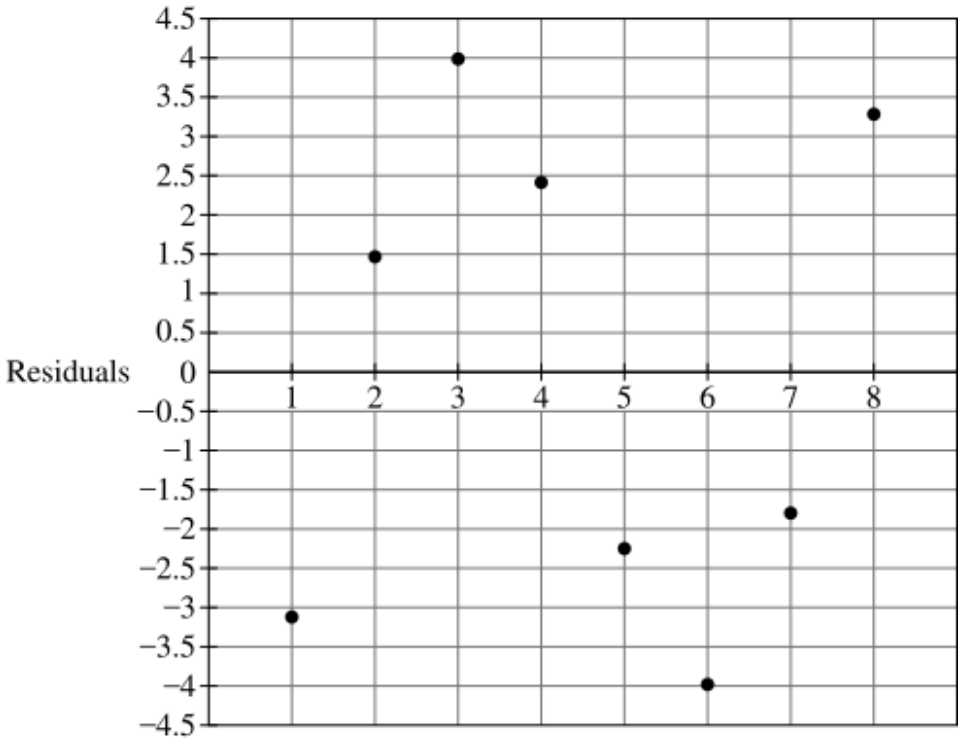
(B) The residual plot for the quadratic regression is without pattern, and the residual plots for the linear and exponential regressions show patterns. Therefore, the linear and exponential models are appropriate.

(C) The residual plots for the linear and exponential regressions are without pattern, and the residual plot for the quadratic regression shows a pattern. Therefore, the linear and exponential models are appropriate.

(D) The residual plot for the quadratic regression is without pattern, and the residual plots for the linear and exponential regressions show patterns. Therefore, the quadratic model is appropriate.

MCQ_Review_Calc

68.



Students in a science class are constructing a model for a data set. The residual plot for their quadratic regression model is given. Which of the following is the best conclusion?

(A) The quadratic model is appropriate because the residuals show a pattern.

(B) The quadratic model is appropriate because the residuals show no pattern.

(C) The quadratic model is not appropriate because the residuals show a pattern.

(D) The quadratic model is not appropriate because the residuals show no pattern.

69.

θ	0	π	2π
$r = f(\theta)$	2	-4	3

The table gives all of the relative extrema of the polar function $r = f(\theta)$ for all input values of θ in the domain of the polar function. Which of the following statements is true about the graph of $r = f(\theta)$ in the polar coordinate system?

(A) The greatest distance between $(f(\theta), \theta)$ and the origin is 3 because this is the maximum value of all the extrema.

(B) The greatest distance between $(f(\theta), \theta)$ and the origin is 3 because this is the maximum of the absolute values of all the extrema.

(C) The greatest distance between $(f(\theta), \theta)$ and the origin is 4 because this is the maximum value of all the extrema.

(D) The greatest distance between $(f(\theta), \theta)$ and the origin is 4 because this is the maximum of the absolute values of all the extrema.

70. The sinusoidal function $y = g(x)$ has a period of $\frac{5\pi}{2}$ and a minimum value at $x = -\frac{3\pi}{2}$. Which of the following statements with reason is true?

(A) The first maximum value for $x > -\frac{3\pi}{2}$ occurs at $x = -\frac{\pi}{2}$, because the smallest interval of input values between the maximum and minimum output values is π.

(B) The first maximum value for $x > -\frac{3\pi}{2}$ occurs at $x = -\frac{\pi}{4}$, because the smallest interval of input values between the maximum and minimum output values is $\frac{1}{2}$ of the period of the sinusoidal function.

(C) The first maximum value for $x > -\frac{3\pi}{2}$ occurs at $x = \frac{\pi}{2}$, because the smallest interval of input values between the maximum and minimum output values is 2π.

(D) The first maximum value for $x > -\frac{3\pi}{2}$ occurs at $x = \pi$, because the smallest interval of input values between the maximum and minimum output values is the period of the sinusoidal function.

71. The function g is given by $g(x) = \sin x - \cos x$ and has a period of 2π. In order to define the inverse function of g, which of the following specifies a restricted domain for g and provides a rationale for why g is invertible on that domain?

(A) $0 \leq x \leq \pi$, because all possible values of $g(x)$ occur without repeating on this interval.

(B) $-\frac{\pi}{4} \leq x \leq \frac{3\pi}{4}$, because all possible values of $g(x)$ occur without repeating on this interval.

(C) $0 \leq x \leq \pi$, because the length of this interval is half of the period.

(D) $-\frac{\pi}{4} \leq x \leq \frac{3\pi}{4}$, because the length of this interval is half of the period.

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72.

x	$g(x)$
0	53
1	78
2	97
3	110
4	117

The table shows values for a function g at selected values of x. Which of the following claim and explanation statements best fits these data?

(A) g is best modeled by a linear function, because the rate of change over consecutive equal-length input-value intervals is constant.

(B) g is best modeled by a linear function, because the change in the average rates of change over consecutive equal-length input-value intervals is constant.

(C) g is best modeled by a quadratic function, because the rate of change over consecutive equal-length input-value intervals is constant.

(D) g is best modeled by a quadratic function, because the change in the average rates of change over consecutive equal-length input-value intervals is constant.