MCQ_Review_Unit_1

1.

x	$r(x)$
1.997	1.3337
1.998	1.3336
1.999	1.3334
2.001	1.3332
2.002	1.3331
2.003	1.3330

The rational function r is given by $r(x) = \frac{x^2-4}{x^2-x-2}$. The table gives values of $r(x)$ for selected values of x. Which of the following statements is true?

(A) $\lim_{x\to 2} r(x) = \frac{4}{3}$, so $r(2) = \frac{4}{3}$.

(B) $\lim_{x\to 2} r(x) = \frac{4}{3}$ and r is undefined at $x = 2$, so the graph of r has a hole at $\left(2, \frac{4}{3}\right)$. ✓

(C) $\lim_{x\to \frac{4}{3}} r(x) = 2$ and r is undefined at $x = 2$, so the graph of r has a hole at $\left(2, \frac{4}{3}\right)$.

(D) $\lim_{x\to 2^+} r(x) = \infty$, $\lim_{x\to 2^-} r(x) = \infty$, and r is undefined at $x = 2$, so the graph of r has a vertical asymptote at $x = 2$.

Answer B

Correct. As the input values get sufficiently close to 2, the output values that correspond get arbitrarily close to (but not equal to) $\frac{4}{3}$.

MCQ_Review_Unit_1

2. The polynomial function p is given by $p(x)=(x+3)\left(x^2-2x-15\right)$. Which of the following describes the zeros of p ?

(A) p has exactly two distinct real zeros. ✓

(B) p has exactly three distinct real zeros.

(C) p has exactly one distinct real zero and no non-real zeros.

(D) p has exactly one distinct real zero and two non-real zeros.

Answer A

Correct. The polynomial function p can be rewritten in fully factored form as $f(x)=(x+3)(x+3)(x-5)=(x+3)^2(x-5)$, showing two distinct real zeros of -3 and 5.

3. In the xy-plane, the graph of the rational function f has a vertical asymptote at $x=4$. Which of the following expressions could define $f(x)$?

(A) $\frac{(x+1)^3(x-4)^2}{(x+1)^2(4-x)^3}$ ✓

(B) $\frac{(x+1)^3(x-4)^2}{(x+1)^2(4-x)^2}$

(C) $\frac{(x+1)^3(x-4)^3}{(x+1)^2(4-x)^2}$

(D) $\frac{(x+1)^2(x-4)^2}{(4x+4)^2(4+x)^3}$

Answer A

Correct. Because the multiplicity of the zero at $x=4$ in the denominator is greater than its multiplicity in the numerator, the graph of the rational function f has a vertical asymptote at $x=4$.

4. The function h is given by $h(x)=\frac{2x^3}{x+3}-\frac{4}{x-1}$. Which of the following statements is true?

(A) h is equivalent to $\frac{2x^4-2x^3-4x-12}{x^2+2x-3}$ and has the same end behavior as the graph of $y=2x^2$. ✓

(B) h is equivalent to $\frac{2x^3-4}{x^2+2x-3}$ and has the same end behavior as the graph of $y=2x$.

(C) h is equivalent to $\frac{2x^3}{x}+\frac{2x^3}{3}-\frac{4}{x-1}$ and has the same end behavior as the graph of $y=2x^2$.

(D) h is equivalent to $\frac{2x^2-2x-12}{3x-3}$ and has the same end behavior as the graph of $y=2x$.

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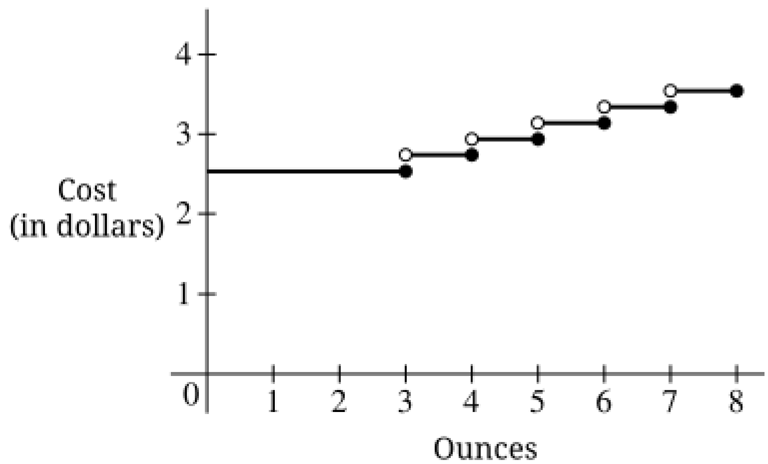
Answer A

Correct. The two fractions are combined into one expression by finding a common denominator of $(x+3)(x-1)$. The quotient of the leading terms is the nonconstant polynomial $y = \frac{2x^4}{x^2}$, which has the same end behavior as the original rational function.

5.



In 2016, the cost to mail a package was $\$2.54$ for up to 3 ounces, plus an additional cost of $\$0.20$ for each additional ounce or portion of an ounce less than a full ounce. A portion of the graph of this relationship is given with cost, in dollars, as a function of ounces. Which of the following describes the restrictions on the range for such a function?

(A) The range is positive real numbers.

(B) The range is positive integers.

(C) The range is values of the form $2.54 + 0.2x$, where x is a nonnegative real number.

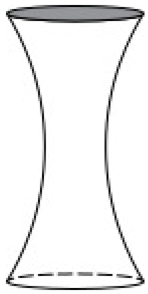
(D) The range is values of the form $2.54 + 0.2x$, where x is a nonnegative integer. ✓

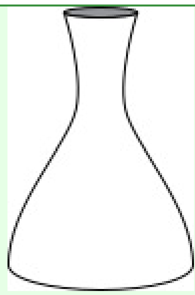
Answer D

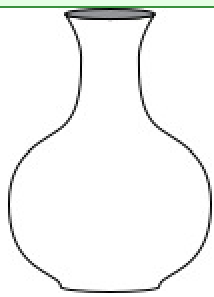
Correct. This range accounts for the restrictions regarding cost of mailing a package as described to accurately model the situation.

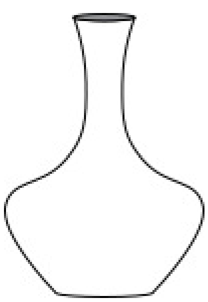
MCQ_Review_Unit_1

6. Water is poured into an empty vase at a constant rate. A graph (not shown) models the depth of the water in the vase over time. The graph can be described as follows: the graph is always increasing; the first portion of the graph is clearly concave up; and the next portion of the graph has a fairly steady and steep increase. Which of the following vases is appropriate for the context described by the graph?

(A) 

(B)  ✓

(C) 

(D) 

Answer B

Correct. The first portion of the graph is concave up due to the decreasing diameter for the bottom portion of the vase, and constant (which would reflect a fairly steady and steep increase in the graph) for

MCQ_Review_Unit_1

the next portion of the vase that appears mostly consistent in diameter.

7. The polynomial function p is given by $p(x) = (x+2)^4$. Which of the following expressions is equivalent to $(x+2)^4$?

(A) $x^4 + 2x^3 + 4x^2 + 8x + 16$

(B) $x^4 + 4x^3 + 6x^2 + 4x + 1$

(C) $x^4 + 8x^3 + 24x^2 + 32x + 16$ ✓

(D) $2x^4 + 8x^3 + 12x^2 + 8x + 2$

Answer C

Correct. The polynomial function p can be written in expanded form by correctly identifying the coefficients using Pascal's Triangle and applying the powers of the variable x and constant 2 correctly.

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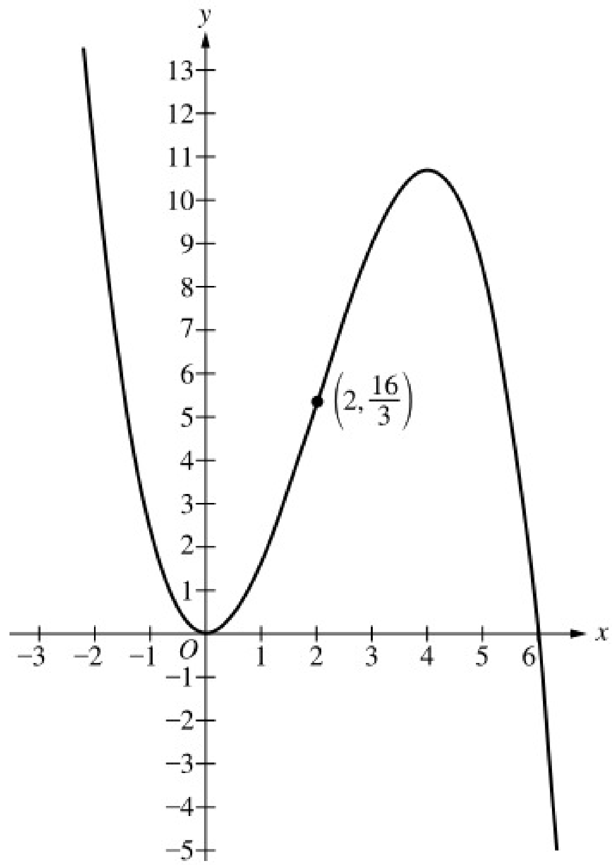
8.



Graph of f

The graph of the function f is given for $-3 \le x \le 6$. Which of the following statements about the rate of change of f over the interval $2 < x < 6$ is true?

(A) The rate of change is positive.

(B) The rate of change is negative.

(C) The rate of change is increasing.

(D) The rate of change is decreasing. ✓

Answer D

Correct. The graph of f is concave down when the rate of change of f is decreasing.

9. The polynomial function f is given by $f(x) = 2x^3 - 3x^2 - 23x + 12$. Which of the following is true about $\frac{f(x)}{x+3}$?

MCQ_Review_Unit_1

(A) The remainder of $\frac{f(x)}{x+3}$ is 0. The quotient of $\frac{f(x)}{x+3}$ is a quadratic polynomial that factors into two linear factors involving only real numbers. ✓

(B) The remainder of $\frac{f(x)}{x+3}$ is 0. The quotient of $\frac{f(x)}{x+3}$ is a quadratic polynomial that does not factor into linear factors involving only real numbers.

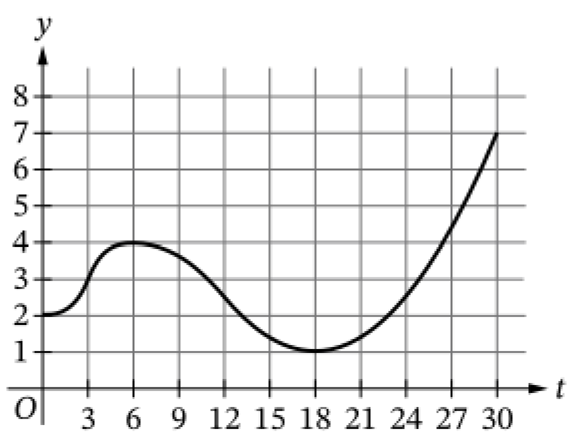
(C) The remainder of $\frac{f(x)}{x+3}$ is a nonzero constant. The quotient of $\frac{f(x)}{x+3}$ is a quadratic polynomial that factors into two linear factors involving only real numbers.

(D) The remainder of $\frac{f(x)}{x+3}$ is a nonzero constant. The quotient of $\frac{f(x)}{x+3}$ is a quadratic polynomial that does not factor into linear factors involving only real numbers.

Answer A

Correct. The quotient of $\frac{f(x)}{x+3}$ is $(2x^2 - 9x + 4)$, and the remainder is 0. The quadratic polynomial factors into $(x - 4)$ and $(2x - 1)$, two linear factors that involve only real numbers.

10.



Graph of W

The depth of water, in feet, at a certain place in a lake is modeled by a function W. The graph of $y = W(t)$ is shown for $0 \leq t \leq 30$, where t is the number of days since the first day of a month. What are all intervals of t on which the depth of water is increasing at a decreasing rate?

(A) $(3,6)$ only ✓

(B) $(3,12)$

(C) $(0,3)$ and $(18,30)$ only

(D) $(0,6)$ and $(18,30)$

MCQ_Review_Unit_1

Answer A

Correct. The function W is increasing, and the graph of W is concave down on the interval $(3,6)$. The rate of change is decreasing on this interval. Therefore, the depth of water is increasing at a decreasing rate on this interval.

11. Jordan's cell phone plan includes 5 gigabytes (GB) of data per month and has a monthly cost of $\$79.95$. If Jordan uses more than 5 GB of data within the month, there is a charge of $\$10$ per additional gigabyte of data used. Function C is used to model Jordan's monthly cell phone bill, where d is the number of gigabytes of data used and $C(d)$ is the cost in dollars. Which of the following defines function C ?

(A) $C(d) = \begin{cases} 79.95 & \text{for } 0 \le d \le 5 \\ 79.95 + 10(d-5) & \text{for } d > 5 \end{cases}$ ✓

(B) $C(d) = \begin{cases} 79.95 & \text{for } 0 \le d \le 5 \\ 79.95 + 10d & \text{for } d > 5 \end{cases}$

(C) $C(d) = \begin{cases} 79.95 & \text{for } 0 \le d \le 5 \\ 79.95d + 10 & \text{for } d > 5 \end{cases}$

(D) $C(d) = 79.95 + 10d$

Answer A

Correct. This piecewise-defined function model is constructed through a combination of determining each linear function and its restricted domain to accurately model the charges that result from the cell phone plan that includes 5 GB of data.

12. For the polynomial function g, $\lim_{x \to -\infty} g(x) = -\infty$. Which of the following expressions could define $g(x)$?

(A) $-5x - 2x^4$ ✓

(B) $-5x^2 - 2x^7$

(C) $-9000x - \frac{x^5}{5}$

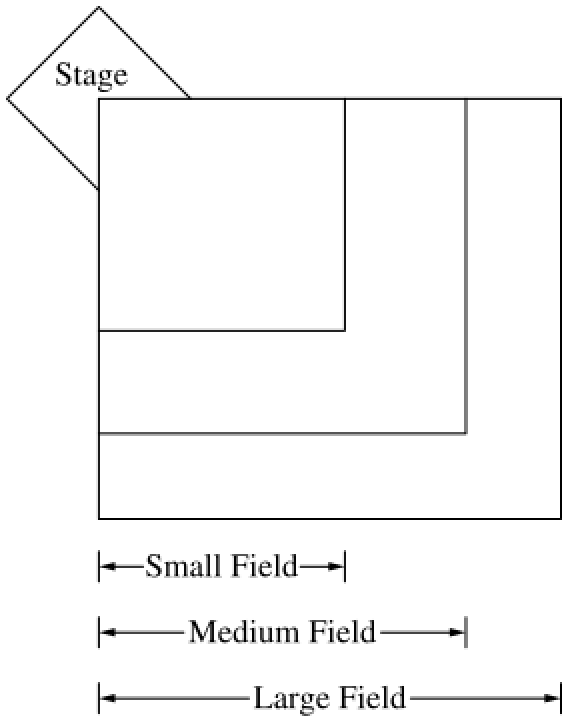
(D) $-x^3 + 2x^4$

MCQ_Review_Unit_1

Answer A

Correct. This expression could define the polynomial function because the leading term, $-2x^4$, has a negative coefficient and is of even degree.

13.



A music agent is planning a series of concerts at local farms around the nation. The agent is building a model to estimate crowd capacity based on different sizes of square fields. Which type of function is most likely to model crowd capacity in this situation?

(A) Linear
(B) Piecewise linear
(C) Quadratic ✓
(D) Cubic

Answer C

Correct. Geometric contexts involving area—in this case, the area of square fields to estimate crowd capacity—can often be modeled by quadratic functions.

14. The rational function r is given by $r(x) = \frac{x^3+8x^2+17x+10}{x^2+2x} = \frac{(x+1)(x+2)(x+5)}{x^2+2x}$. Which of the following gives equations for all the horizontal asymptotes, vertical asymptotes, and slant asymptotes of the graph of r ?

(A) $x = 0$ and $y = x + 6$ ✓

(B) $x = 0$ and $x = -2$

(C) $x = 0$ and $y = 5x + 10$

(D) $x = 0$ and $y = x + 10$

Answer A

Correct. The rational function has been factored completely. The graph has a vertical asymptote at $x = 0$ because x is a zero of the polynomial in the denominator and is not also a zero of the polynomial in the numerator. Polynomial long division has been used correctly, and the quotient of $(x + 6)$ gives information about an equation of the slant asymptote.

15. The function f is given by $f(x) = (x + 3)^4$. When f is rewritten in the form $f(x) = x^4 + ax^3 + bx^2 + cx + d$, which of the following values is greatest?

(A) a

(B) b

(C) c ✓

(D) d

Answer C

Correct. The polynomial function f, when written in expanded form by correctly identifying the coefficients using Pascal's Triangle and applying the powers of the variable x and constant 3 correctly, has a greatest coefficient value of $4 \cdot 3^3 = 108$.

MCQ_Review_Unit_1

16.

Interval	$0 < x < 1$	$1 < x < 2$	$2 < x < 3$	$3 < x < 4$	$4 < x < 5$	$5 < x < 6$	$6 < x < 7$
Change in $f(x)$	2.1	2.0	2.1	2.2	2.1	2.2	2.0
Change in $g(x)$	2.1	3.2	4.2	5.1	6.3	7.2	8.3
Change in $h(x)$	2.1	2.0	2.1	4.2	4.1	4.2	4.0
Change in $k(x)$	2.1	3.2	4.2	5.1	4.2	3.2	2.1

The table gives the average rates of change for the functions f, g, h, and k for certain intervals of x. Which of the functions is best modeled by a piecewise-linear function with two linear segments with different slopes?

(A) f

(B) g

(C) h ✓

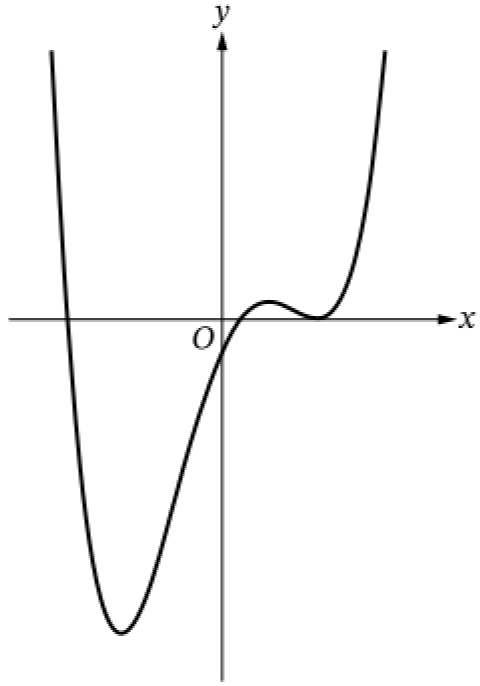
(D) k

Answer C

Correct. Because the rates of change are roughly two different constants over two different intervals, the function is best modeled by a piecewise-linear function for the intervals given in the table.

MCQ_Review_Unit_1

17.



Graph of g

The figure shown is the graph of a polynomial function g. Which of the following could be an expression for $g(x)$?

(A) $0.25(x-5)(x-1)(x+8)$

(B) $0.25(x+5)(x+1)(x-8)$

(C) $0.25(x-5)^2(x-1)(x+8)$ ✓

(D) $0.25(x+5)^2(x+1)(x-8)$

Answer C

Correct. Polynomial function g is a polynomial of even degree with a positive leading coefficient and three distinct real zeros. The linear factors $(x-a)$ mean that the zeros of the function occur at the values of a. One of the zeros, $x=5$, has even multiplicity 2, and the graph is tangent to the x-axis at that point.

18. The function f is defined for all real values of x. For a constant a, the average rate of change of f from $x=a$ to $x=a+1$ is given by the expression $2a+1$. Which of the following statements is true?

MCQ_Review_Unit_1

(A) The average rate of change of f over consecutive equal-length input-value intervals is positive, so the graph of f could be a line with a positive slope.

(B) The average rate of change of f over consecutive equal-length input-value intervals is positive, so the graph of f could be a parabola that opens up.

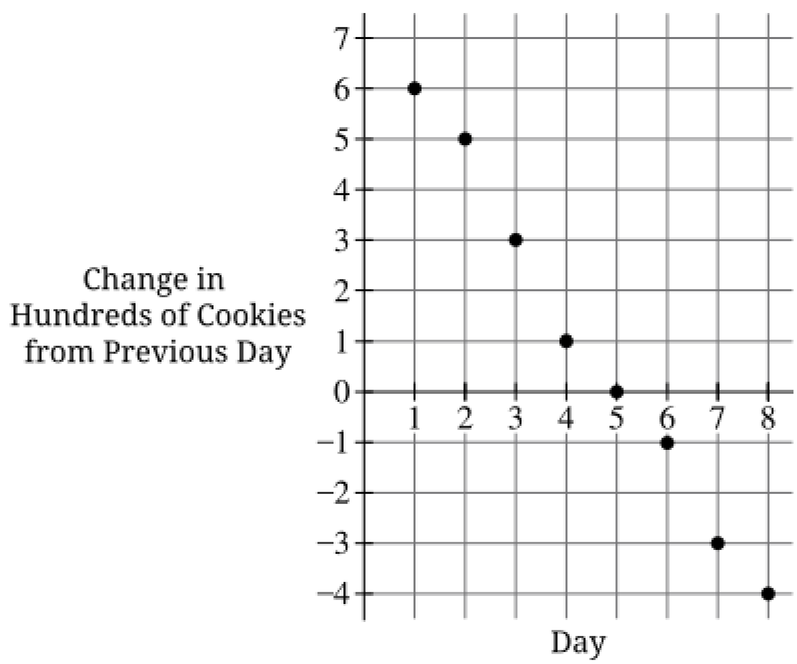
(C) The average rate of change of f over consecutive equal-length input-value intervals is increasing at a constant rate, so the graph of f could be a line with a positive slope.

(D) The average rate of change of f over consecutive equal-length input-value intervals is increasing at a constant rate, so the graph of f could be a parabola that opens up.

Answer D

Correct. The rate of change of a quadratic function can be given by a linear function, such as the given average rate of change expression $2a + 1$. Because the rate of change is increasing (the slope is positive), the graph of the function is concave up.

19.



At a bakery, the number of cookies baked each day changes based on anticipated demand. The scatterplot shows the change in hundreds of cookies baked from the previous day for eight days. The point at $(2, 5)$ means that on day 2, the number of cookies baked will be 500 more than the number of cookies baked on day 1. A function model C is to be constructed for the number of cookies baked on each of the days, 0 through 8. Which of the following statements best supports the selection of a model for C ?

MCQ_Review_Unit_1

(A) Because the information about rate of change is roughly linear, a linear model is best for C.

(B) Because the information about rate of change is roughly linear, a quadratic model is best for C. ✓

(C) Because the information about rate of change is positive and negative, a quadratic model is best for C.

(D) Because the information about rate of change is positive and negative, a piecewise-linear model is best for C.

Answer B

Correct. Quadratic functions model data sets that demonstrate roughly linear rates of change.

20. The ancient Pythagoreans studied figurate numbers, which are numbers that can be shown by taking dots or spheres and arranging them into geometric shapes. For example, the square numbers are 1, 4, 9, 16, 25, etc., and each of these numbers of dots can be arranged into a square. The tetrahedral numbers similarly specify the number of spheres needed to create a tetrahedron, which is a triangular-based pyramid. The tetrahedral numbers are 1, 4, 10, 20, 35, 56, 84, etc. Which of the following statements is true?

(A) The tetrahedral numbers are best modeled by a quadratic function because the 2nd differences are a nonzero constant.

(B) The tetrahedral numbers are best modeled by a quadratic function because the 3rd differences are a nonzero constant.

(C) The tetrahedral numbers are best modeled by a cubic function because the 2nd differences are a nonzero constant.

(D) The tetrahedral numbers are best modeled by a cubic function because the 3rd differences are a nonzero constant. ✓

Answer D

Correct. A polynomial function of degree 3 models the tetrahedral numbers because they demonstrate constant nonzero 3rd differences.

21. For a polynomial function f, $\lim_{x \to -\infty} f(x) = \infty$ and $\lim_{x \to \infty} f(x) = -\infty$. Which of the following must be true about f ?

MCQ_Review_Unit_1

(A) The degree of f is even, and the leading coefficient is negative.

(B) The degree of f is even, and the leading coefficient is positive.

(C) The degree of f is odd, and the leading coefficient is negative. ✓

(D) The degree of f is odd, and the leading coefficient is positive.

Answer C

Correct. The output values of the polynomial increase without bound as the input values decrease without bound (the graph goes up to the left), and the output values decrease without bound as the input values increase without bound (the graph goes down to the right). This indicates that the polynomial is of odd degree with a negative leading coefficient.

22. The function f is given by $f(x) = -2x^7 + 5x^4 + 6x^2 - 3$. Which of the following correctly describes the end behavior of f as the input values increase without bound?

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

(B) $\lim_{x \to \infty} f(x) = -\infty$ ✓

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

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

Answer B

Correct. Because the function is an odd degree polynomial with a negative leading coefficient, the output values decrease without bound as the input values increase without bound (the graph goes down to the right).

23. The polynomial function p is given by $p(x) = -4x^5 + 3x^2 + 1$. Which of the following statements about the end behavior of p is true?

MCQ_Review_Unit_1

(A) The sign of the leading term of p is positive, and the degree of the leading term of p is even; therefore, $\lim_{x \to -\infty} p(x) = \infty$ and $\lim_{x \to \infty} p(x) = \infty$.

(B) The sign of the leading term of p is negative, and the degree of the leading term of p is odd; therefore, $\lim_{x \to -\infty} p(x) = \infty$ and $\lim_{x \to \infty} p(x) = -\infty$. ✓

(C) The sign of the leading term of p is positive, and the degree of the leading term of p is odd; therefore, $\lim_{x \to -\infty} p(x) = -\infty$ and $\lim_{x \to \infty} p(x) = \infty$.

(D) The sign of the leading term of p is negative, and the degree of the leading term of p is odd; therefore, $\lim_{x \to -\infty} p(x) = -\infty$ and $\lim_{x \to \infty} p(x) = \infty$.

Answer B

Correct. The leading term of polynomial function p is $-4x^5$. A polynomial of odd degree with a negative leading coefficient behaves like the graph of $f(x) = -x^3$. The output values increase without bound as the input values decrease without bound. Thus, $\lim_{x \to -\infty} p(x) = \infty$. The output values decrease without bound as the input values increase without bound. Thus, $\lim_{x \to \infty} p(x) = -\infty$.

24. The function f is given by $f(x) = 5x^6 - 2x^3 - 3$. Which of the following describes the end behavior of f ?

(A) $\lim_{x \to -\infty} f(x) = -\infty$ and $\lim_{x \to \infty} f(x) = -\infty$

(B) $\lim_{x \to -\infty} f(x) = \infty$ and $\lim_{x \to \infty} f(x) = \infty$ ✓

(C) $\lim_{x \to -\infty} f(x) = -\infty$ and $\lim_{x \to \infty} f(x) = \infty$

(D) $\lim_{x \to -\infty} f(x) = \infty$ and $\lim_{x \to \infty} f(x) = -\infty$

Answer B

Correct. The degree (even) and sign of the leading term (positive) have been appropriately identified and used to determine the end behavior of the function.

25. The polynomial function p is an odd function. If $p(3) = -4$ is a relative maximum of p, which of the following statements about $p(-3)$ must be true?

MCQ_Review_Unit_1

(A) $p(-3) = 4$ is a relative maximum.

(B) $p(-3) = -4$ is a relative maximum.

(C) $p(-3) = 4$ is a relative minimum. ✓

(D) $p(-3) = -4$ is a relative minimum.

Answer C

Correct. As an odd function, polynomial function p has the property $f(-x) = -f(x)$ and is graphically symmetric about the point $(0,0)$.

26. The function f is given by $f(x) = 3x^2 + 2x + 1$. The graph of which of the following functions is the image of the graph of f after a vertical dilation of the graph of f by a factor of 2 ?

(A) $m(x) = 12x^2 + 4x + 1$, because this is a multiplicative transformation of f that results from multiplying each input value x by 2.

(B) $k(x) = 6x^2 + 4x + 2$, because this is a multiplicative transformation of f that results from multiplying $f(x)$ by 2. ✓

(C) $p(x) = 3(x+2)^2 + 2(x+2) + 1$, because this is an additive transformation of f that results from adding 2 to each input value x.

(D) $n(x) = 3x^2 + 2x + 3$, because this is an additive transformation of f that results from adding 2 to $f(x)$.

Answer B

Correct. A vertical dilation of the graph of f by a factor of 2 results in $k(x) = 2f(x)$.

27.

x	-1	1	3	5	7
$f(x)$	-36	0	4	0	12

Values of the polynomial function f for selected values of x are given in the table. If all of the zeros of the function f are given in the table, which of the following must be true?

(A) The function f has a local minimum at $(-1, -36)$.

(B) The function f has a local minimum at $(5, 0)$.

(C) The function f has a local maximum at $(3, 4)$.

(D) The function f has a local maximum at $(1, 0)$.

Answer B

Correct. Because the polynomial function changes from decreasing to increasing, and all zeros of the function are given in the table, the polynomial has a local minimum at $(5, 0)$.

28. The function f has a negative average rate of change on every interval of x in the interval $0 \leq x \leq 10$. The function g has a negative average rate of change on every interval of x in the interval $0 \leq x < 5$, and a positive average rate of change on every interval of x in the interval $5 < x \leq 10$. Which of the following statements must be true about the function h, defined by $h(x) = f(x) + g(x)$, on the interval $0 \leq x \leq 10$?

(A) h is decreasing on $0 \leq x \leq 10$.

(B) h is decreasing on $0 \leq x < 5$; h is increasing on $5 < x \leq 10$.

(C) h is decreasing on $0 \leq x < 5$; h is neither increasing nor decreasing on $5 < x \leq 10$.

(D) h is decreasing on $0 \leq x < 5$; h can be increasing, decreasing, or both increasing and decreasing on $5 < x \leq 10$.

Answer D

Correct. It can be determined that h is decreasing on the interval $0 \leq x < 5$ because both f and g have a negative average rate of change on this interval. Without knowing the magnitude that results from the combination of positive and negative average rates of change on the interval $5 < x \leq 10$, it is necessary to assume that the function h could be increasing, decreasing, or a combination of both increasing and decreasing on this interval.

29. The functions g and f are given by $g(x) = 3x^2 - 2x$ and $f(x) = 6x^4 + 5x^3 + 3x - 5$. Which of the following statements is true about the remainder when $f(x)$ is divided by $g(x)$?

MCQ_Review_Unit_1

(A) The remainder is 0, so $g(x)$ is a factor of $f(x)$.

(B) The remainder is 0, so $f(x)$ is a factor of $g(x)$.

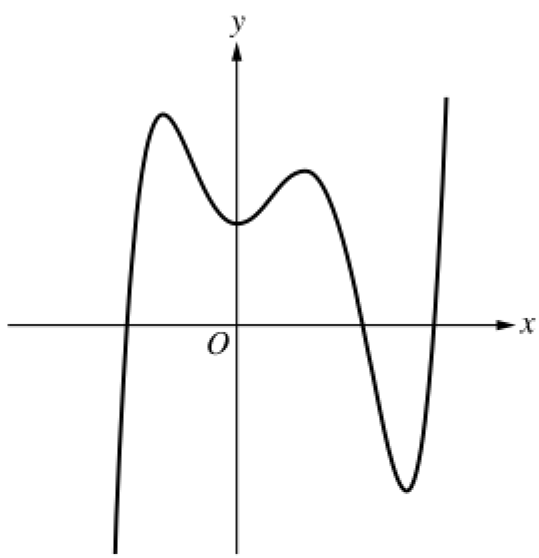
(C) The remainder is $(7x-5)$, so $g(x)$ is not a factor of $f(x)$, and the graph of $y=\frac{f(x)}{g(x)}$ has a slant asymptote.

(D) The remainder is $(7x-5)$, so $g(x)$ is not a factor of $f(x)$, and the graph of $y=\frac{f(x)}{g(x)}$ does not have a slant asymptote.

Answer D

Correct. This is a result of completing the polynomial long division correctly to find the quotient of $\left(2x^2+3x+2\right)$ and remainder of $(7x-5)$. Since the quotient is not linear, there is no slant asymptote.

30.



Graph of f

The graph of the polynomial function f is shown. How many points of inflection does the graph of f have on the given portion of the graph?

(A) One

(B) Three

(C) Four

(D) Five

Answer B

Correct. The rates of change of the rate of change polynomial function f change from increasing to decreasing or decreasing to increasing three times, resulting in three points of inflection on the given portion of the graph.

31. The polynomial function f is given by $f(x) = (x-4)(3x-1)^2$. Which of the following descriptions of f is true?

(A) f is a polynomial of degree 2 with a leading coefficient of 3.

(B) f is a polynomial of degree 2 with a leading coefficient of 9.

(C) f is a polynomial of degree 3 with a leading coefficient of 3.

(D) f is a polynomial of degree 3 with a leading coefficient of 9. ✓

Answer D

Correct. This polynomial function written in expanded form is $f(x) = 9x^3 - 42x^2 + 25x - 4$.

32. A polynomial function has the form $p(x) = ax^j + bx^k$, where a and b are nonzero constants, j and k are nonnegative integers. Which of the following conditions guarantees that p is an even function?

(A) $k = 0$

(B) $j = 2k$ and k is even. ✓

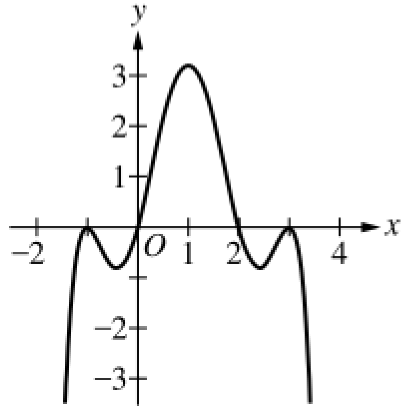
(C) $j + k$ is even.

(D) $j \cdot k$ is even.

Answer B

Correct. Any even integer, k, times 2 always results in an even product, j. The function will always be an even function.

33.



Graph of g

The graph of the polynomial function g is shown. The function f is defined for $0 \leq x \leq 3$ and is identical to the function g on that interval. How many total local minima and local maxima does the function f have?

(A) Two

(B) Four

(C) Five

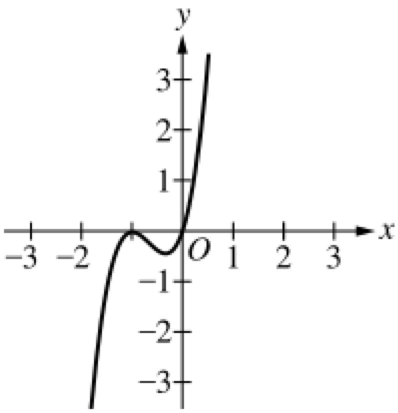
(D) Seven

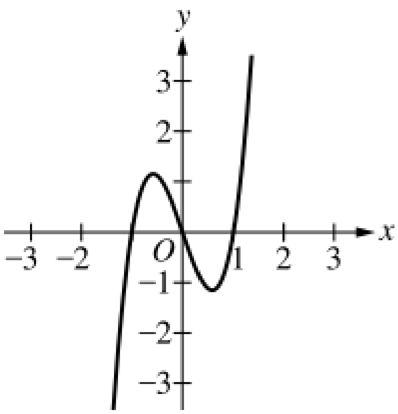
Answer B

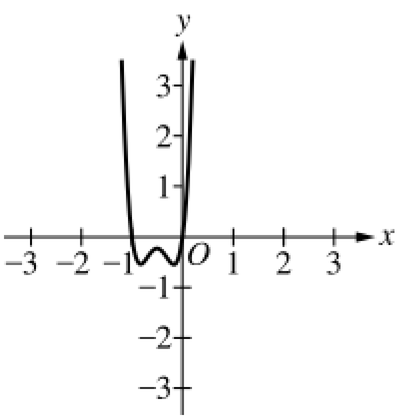
Correct. There are two values within the domain of f, $x = 1$ and $x = 2.4$ (approximately), that change from increasing to decreasing or decreasing to increasing, and two endpoints, due to the restricted domain, of $x = 0$ and $x = 3$, that result in local minima and maxima for the polynomial function.

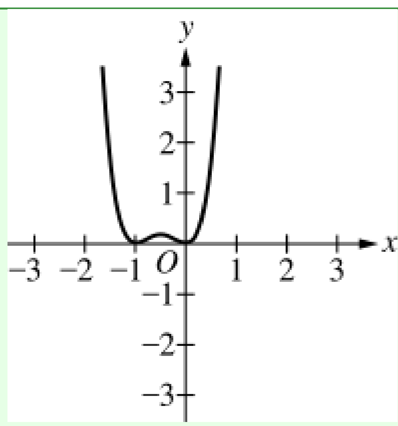
34. The polynomial function P is given by $P(x) = 3x(x+1)^2(x-a)$, where a is a real number. Which of the following could be the graph of $y = P(x)$?

MCQ_Review_Unit_1

(A) 

(B) 

(C) 

(D) 

MCQ_Review_Unit_1

Answer D

Correct. This graph could be the polynomial function P when $a = 0$ because the graph has 2 points of tangency, $x = -1$ and $x = 0$, meaning both of the zeros must have even multiplicity. In this case, each zero occurs twice.

35.

x	$Q(x)$
-4	389
-3	139
-2	35
-1	5
0	1
1	-1
2	-1
3	25
4	125

The table gives values of a polynomial function Q for selected values of x. What is the degree of Q ?

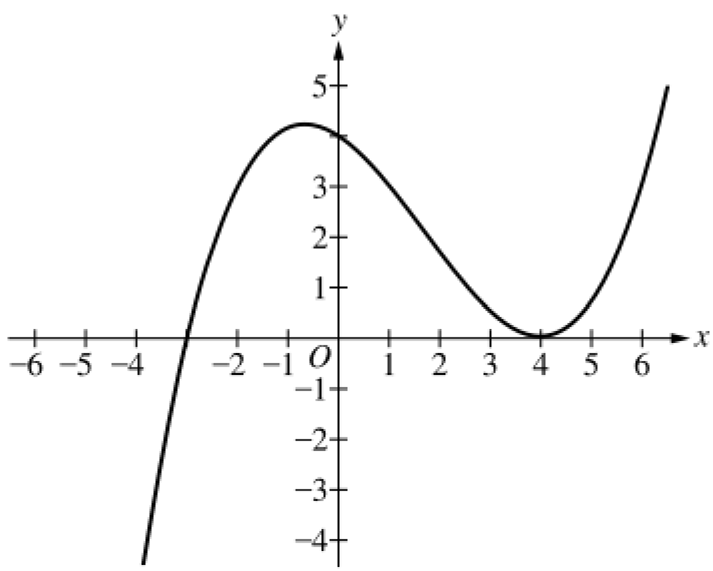
MCQ_Review_Unit_1

(A) 2
(B) 3
(C) 4 ✓
(D) 5

Answer C

Correct. The fourth differences of the outputs of the polynomial function are all 24 (constant differences in output values), making Q a fourth-degree (quartic) polynomial.

36.



Graph of P

The graph of the polynomial function $y = P(x)$ is shown. Which of the following could define $P(x)$?

(A) $P(x) = \frac{(x-4)(x+3)^2}{12}$
(B) $P(x) = \frac{(x-4)^2(x+3)}{12}$ ✓
(C) $P(x) = \frac{(x+4)(x-3)^2}{12}$
(D) $P(x) = \frac{(x+4)^2(x-3)}{12}$

MCQ_Review_Unit_1

Answer B

Correct. The factor $(x-4)$ of the polynomial function indicates even multiplicity (represented by the exponent) of the zero, resulting in the graph running tangent to the x-axis at the zero at $x=4$. The factor $(x+3)$ indicates odd multiplicity of the zero, resulting in the graph going through the x-axis at the zero at $x=-3$.

37. The leading term of the polynomial function p is $a_n x^n$, where a_n is a real number and n is a positive integer. The factors of p include $(x-3)$, $(x-i)$, and $(x-(2+i))$. What is the least possible value of n ?

(A) 3

(B) 4

(C) 5 ✓

(D) 6

Answer C

Correct. Each non-real zero, and its conjugate, must be a zero of the polynomial function. This means p also has zeros of $-i$ and $(2-i)$, making 5 the least possible number of zeros of the polynomial.

38. The function Q is a polynomial of degree 3. If $Q(5)=0$, which of the following must be true?

(A) $Q(-5)=0$

(B) Q has two complex zeros.

(C) $Q(x)$ can be expressed as $(x-5)\cdot P(x)$, where $P(x)$ is a polynomial of degree 2. ✓

(D) $Q(x)$ can be expressed as $\frac{P(x)}{x-5}$, where $P(x)$ is a polynomial of degree 4.

Answer C

Correct. 5 is a zero of the polynomial, making $(x-5)$ one of its factors. Multiplying a polynomial of degree 2 by a linear factor results in a polynomial of degree 3.

MCQ_Review_Unit_1

39.

x	-3	3	6
$f(x)$	-10	-2	2

The table gives values of the function f for selected values of x. If the function f is linear, what is the value of $f(13)$?

(A) 4

(B) $\frac{29}{4}$

(C) $\frac{28}{3}$

(D) $\frac{34}{3}$ ✓

Answer D

Correct. Using the provided values in the table, the rate of change of the linear function can be found to be $\frac{4}{3}$. The linear function is $f(x) = \frac{4}{3}x - 6$. Using the slope of $\frac{4}{3}$ and the x-value of 13, the y-value can be solved to be $\frac{34}{3}$.

40.

Interval	$0 \le x \le 1$	$1 \le x \le 4$	$4 \le x \le 8$	$8 \le x \le 10$
Average Rate of Change	10	-5	2	6

The table gives the average rates of change of a function f over different intervals. On which of the intervals does the function increase the most?

(A) $0 \le x \le 1$

(B) $1 \le x \le 4$

(C) $4 \le x \le 8$

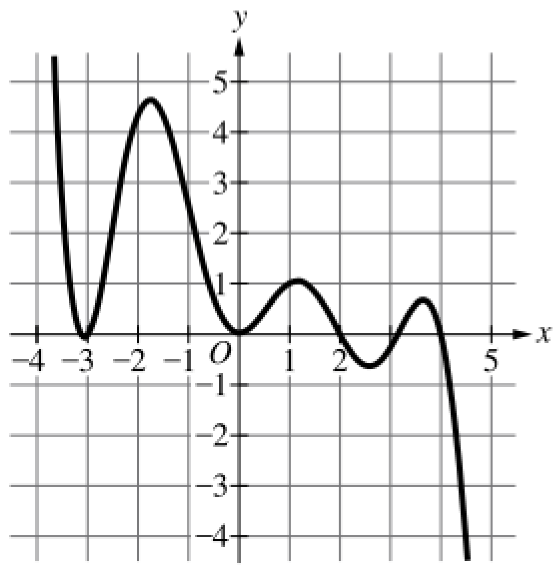
(D) $8 \le x \le 10$ ✓

MCQ_Review_Unit_1

Answer D

Correct. The interval length is 2 units, and the average rate of change per unit is 6 for a total increase of 12 over the interval $8 \leq x \leq 10$.

41.



Graph of g

The graph of the function $y = g(x)$ is given. Of the following, on which interval is the average rate of change of g least?

(A) $-3 \leq x \leq -2$

(B) $-1 \leq x \leq 0$ ✓

(C) $1 \leq x \leq 2$

(D) $3 \leq x \leq 4$

Answer B

Correct. The average rate of change is approximately -2.5 for this interval, which is the least value among the intervals provided as options.

42. The average rate of change of the quadratic function p is -4 on the interval $0 \leq x \leq 2$ and -1 on the interval $2 \leq x \leq 4$. What is the average rate of change of p on the interval $6 \leq x \leq 8$?

(A) 2

(B) 3

(C) 5 ✓

(D) The average rate of change on the interval $6 \le x \le 8$ cannot be determined from the information given.

Answer C

Correct. The average rate of change of a quadratic function over consecutive equal-length input-value intervals can be given by a linear function. The change in the average rate of change from $0 \le x \le 2$ to $2 \le x \le 4$ is 3. For each consecutive interval, the average rate of change must increase by 3.

43.

Time (seconds)	1	3	6	11
Distance (meters)	1	9	21	41

An object is moving in a straight line from a starting point. The distance, in meters, from the starting point at selected times, in seconds, is given in the table. If the pattern is consistent, which of the following statements about the rate of change of the rates of change of distance over time is true?

(A) The rate of change of the rates of change is 0 meters per second, and the object is neither speeding up nor slowing down.

(B) The rate of change of the rates of change is 0 meters per second per second, and the object is neither speeding up nor slowing down. ✓

(C) The rate of change of the rates of change is 4 meters per second, and the object is neither speeding up nor slowing down.

(D) The rate of change of the rates of change is 4 meters per second per second, and the object is speeding up.

Answer B

Correct. The rate of change of the object is 4 meters per second over each interval, making the scenario a linear function model. Because the rate of change of the object is constant, the rate of change of the rates of change is 0 meters per second per second, meaning the object does not speed up or slow down.

MCQ_Review_Unit_1

44.

x	-2	-1	0	1
$f(x)$	5	2	1	2

The table gives values of a function f for selected values of x. Which of the following conclusions with reason is consistent with the data in the table?

(A) f could be a linear function because the rates of change over consecutive equal-length intervals in the table can be described by $y = 2x$.

(B) f could be a linear function because the rates of change over consecutive equal-length intervals in the table can be described by $y = 2x + 1$.

(C) f could be a quadratic function because the rates of change over consecutive equal-length intervals in the table can be described by $y = 2x$.

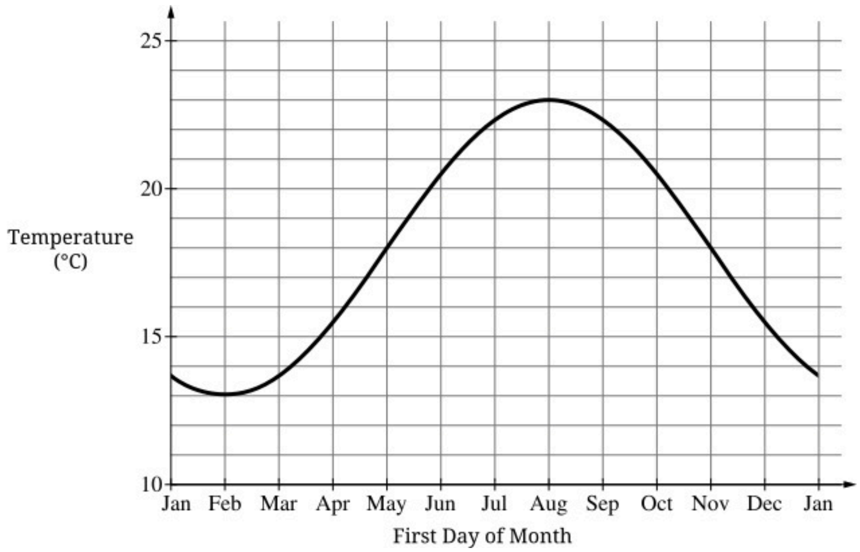
(D) f could be a quadratic function because the rates of change over consecutive equal-length intervals in the table can be described by $y = 2x + 1$. ✓

Answer D

Correct. For consecutive equal-length input-value intervals, as in the table of values for function f, the average rate of change of a quadratic can be given by a linear function. The first differences of -3, -1, and 1 can be modeled by the linear function $y = 2x + 1$. The second differences of 2 are constant.

MCQ_Review_Unit_1

45.



The daily high temperature at a certain point in a river is modeled by the graph. Each point on a vertical gridline indicates the temperature, in degrees Celsius, on the first day of the indicated month. Of the following, on the first day of which month is the rate of change of the temperature the greatest?

(A) February

(B) May ✓

(C) August

(D) November

Answer B

Correct. Using the graph, the rate of change can be estimated to be the greatest positive value among the options given.

MCQ_Review_Unit_1

46.

x	$1 < x < 2$	$2 < x < 3$	$3 < x < 4$	$4 < x < 5$
Rate of change of $f(x)$	Positive and increasing	Negative and increasing	Positive and decreasing	Negative and decreasing

The table gives characteristics of the rates of change of the function f on different intervals. Which of the following is true about f on the interval $3 < x < 4$?

(A) f is increasing, and the graph of f is concave down. ✓

(B) f is increasing, and the graph of f is concave up.

(C) f is decreasing, and the graph of f is concave down.

(D) f is decreasing, and the graph of f is concave up.

Answer A

Correct. The positive rate of change of f on this interval means the function is increasing, and the decreasing rate of change means the graph is concave down.

47. The function f is not explicitly given. The function g is given by $g(x) = f(x+1) - f(x)$. The function h is given by $h(x) = g(x+1) - g(x)$. If $h(x) = -6$ for all values of x, which of the following statements must be true?

(A) Because h is negative and constant, the graphs of g and f always have negative slope.

(B) Because h is negative and constant, the graphs of g and f are concave down.

(C) Because h is negative and constant, g is decreasing, and the graph of f always has negative slope.

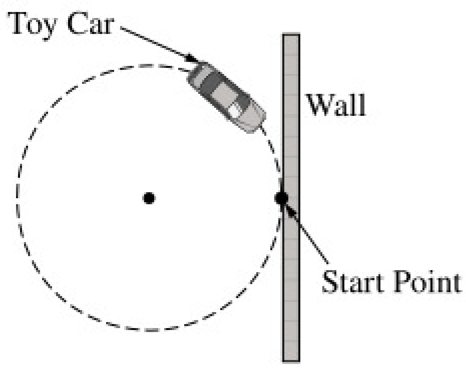
(D) Because h is negative and constant, g is decreasing, and the graph of f is concave down. ✓

Answer D

Correct. The graph of f is concave down because the average rate of change of f, as given by function g, is decreasing as a result of h being a negative constant function.

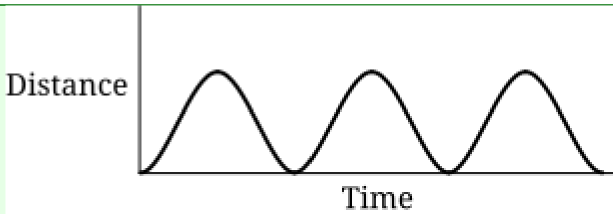
MCQ_Review_Unit_1

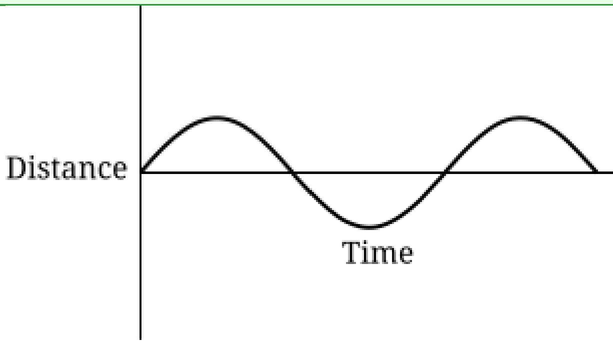
48.

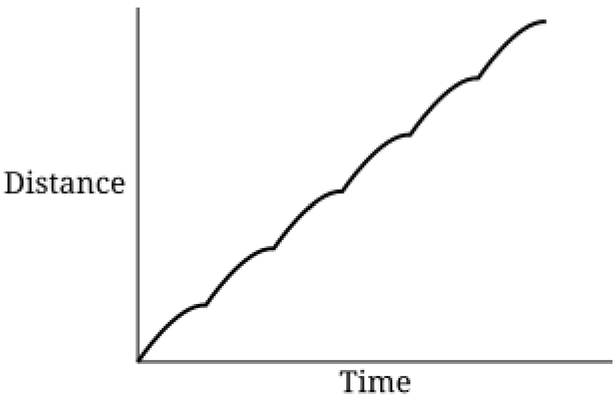


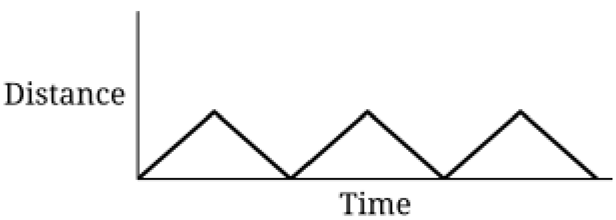
A toy car travels around a circular track as shown in the figure. As the toy car travels around the track, its distance from the wall can be modeled by a graph where the y-axis represents the distance between the car and the wall, and the x-axis represents time. Which of the following graphs models this relationship as the car goes around the track three times without stopping?

MCQ_Review_Unit_1

(A)


(B)


(C)


(D)


Answer A

Correct. As the car travels around the track, it would return to the wall at three times throughout its travels, meaning there would need to be three positive x-intercepts. The rate of change of the graph would be changing as the toy car travels around the track.

49. The rational function f is given by $f(x) = \frac{x^k(x-1)(x+3)}{x^5+2x-5}$, where k is a positive integer. For which of the following values of k will the graph of f have a horizontal asymptote at $y = 0$?

(A) 2 ✓
(B) 3
(C) 4
(D) 5

Answer A

Correct. A rational function has a horizontal asymptote at $y = 0$ when the degree of the polynomial in the denominator is greater than the degree of the polynomial in the numerator. Because the degree of the polynomial in the denominator is 5, the degree of the polynomial in the numerator must be 4 or less, meaning k must be 2 or less.

50. The rational function r is given by $r(x) = \frac{(2x-3)(x-4)(x-2)}{(3x-1)(2x+1)(x-1)}$ and is equivalent to $r(x) = \frac{p(x)}{q(x)}$, where p and q are polynomial functions. Which of the following statements is true?

(A) The degree of p is less than the degree of q, and $\lim_{x\to\infty} r(x) = 0$.
(B) The degree of p is greater than the degree of q, and $\lim_{x\to\infty} r(x) = \infty$.
(C) The degree of p is equal to the degree of q, and $\lim_{x\to\infty} r(x) = 0$.
(D) The degree of p is equal to the degree of q, and $\lim_{x\to\infty} r(x) = \frac{1}{3}$. ✓

Answer D

Correct. Neither of the polynomials in the numerator and denominator dominates the other. The quotient of the leading terms is a constant, $\frac{1}{3}$, and that constant indicates the location of a horizontal asymptote of the graph, $y = \frac{1}{3}$. This also provides information about the end behavior of the function r.

51. The rational function h is expressed as the quotient of two polynomial functions f and g by $h(x) = \frac{f(x)}{g(x)}$. The function f is given by $f(x) = 6x^3 - x^2 + 60x - 25$. If the graph of h has a slant asymptote of $y = 2x - 1$, which of the following describes g ?

(A) g has degree 2 with leading coefficient 3. ✓
(B) g has degree 2 with leading coefficient 12.
(C) g has degree 3 with leading coefficient 3.
(D) g has degree 4 with leading coefficient 12.

MCQ_Review_Unit_1

Answer A

Correct. The graph of a rational function has a slant asymptote when the highest degree term in the denominator, $3x^2$, has one degree less than the highest degree term in the numerator, $6x^3$. The leading coefficient in the denominator, 3, divides the leading coefficient in the numerator, 6, evenly, resulting in a slant asymptote slope of 2.

52. The rational function h is given by $h(x) = \frac{2x^5+5x^3-2x^2-13}{3x^2-2x+7}$. Which of the following describes the end behavior of h ?

(A) As x increases without bound, $h(x)$ increases without bound, and as x decreases without bound, $h(x)$ decreases without bound. ✓

(B) As x increases without bound, $h(x)$ increases without bound, and as x decreases without bound, $h(x)$ increases without bound.

(C) As x increases without bound, $h(x)$ decreases without bound, and as x decreases without bound, $h(x)$ increases without bound.

(D) As x increases without bound, $h(x)$ decreases without bound, and as x decreases without bound, $h(x)$ decreases without bound.

Answer A

Correct. The end behavior of the rational function can be determined to behave like the quotient of the leading terms, $\frac{2}{3}x^3$, an odd function with a positive leading coefficient.

53. A polynomial function p has three distinct zeros each with multiplicity 1, and its leading coefficient is positive. The polynomial function q has exactly one zero with multiplicity 3, and its leading coefficient is negative. The rational function h can be written as the quotient of p and q by $h(x) = \frac{p(x)}{q(x)}$. Which of the following statements about h must be true?

(A) The graph of h has a horizontal asymptote at $y = 0$.

(B) The graph of h has a horizontal asymptote at $y = a$, where $a > 0$.

(C) The graph of h has a horizontal asymptote at $y = a$, where $a < 0$. ✓

(D) The graph of h has no horizontal asymptote.

Answer C

Correct. Polynomial functions p and q are both polynomials of degree 3. Neither of the polynomials dominates the rational function. The ratio of the leading terms is a negative constant that determines the location of a horizontal asymptote of the graph of the rational function.

54.

x	$0 < x < 1$	$1 < x < 2$	$2 < x < 3$	$3 < x < 4$
Rate of change of f on the interval of x	Increasing	Positive and Constant	Decreasing	Negative and Constant

The table describes rates of change of a function f for selected intervals of x. The function f is defined for $0 \leq x \leq 4$. On which of the following intervals is the graph of f concave down?

(A) $0 < x < 1$

(B) $1 < x < 2$

(C) $2 < x < 3$ ✓

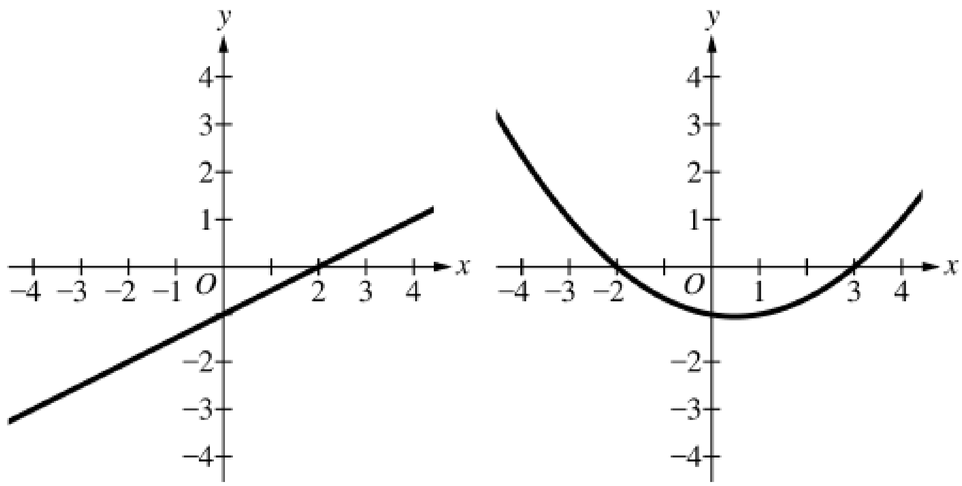
(D) $3 < x < 4$

Answer C

Correct. The graph of a function is concave down on intervals in which the rate of change is decreasing.

MCQ_Review_Unit_1

55.



The graphs of the polynomial functions f and g are shown. The function h is defined by $h(x) = \frac{f(x)}{g(x)}$. What are all vertical asymptotes of the graph of $y = h(x)$?

(A) $x = 2$ only

(B) $x = 3$ only

(C) $x = -2$ and $x = 3$ only ✓

(D) $x = -2$, $x = 2$, and $x = 3$

Answer C

Correct. The vertical asymptotes of the graph of h are the real zeros, $x = -2$ and $x = 3$, of the polynomial in the denominator.

56. The function g is given by $g(x) = x^3 - 3x^2 - 18x$, and the function h is given by $h(x) = x^2 - 2x - 35$. Let k be the function given by $k(x) = \frac{h(x)}{g(x)}$. What is the domain of k ?

(A) all real numbers x where $x \neq 0$

(B) all real numbers x where $x \neq -5, x \neq 7$

(C) all real numbers x where $x \neq -3, x \neq 0, x \neq 6$ ✓

(D) all real numbers x where $x \neq -5, x \neq -3, x \neq 0, x \neq 6, x \neq 7$

MCQ_Review_Unit_1

Answer C

Correct. The function k is equivalent to $\frac{(x-7)(x+5)}{x(x-6)(x+3)}$ in factored form.

The values of $g(x) = 0$ results in division by zero for the function k, which means function k is undefined at those values.

Let f be a rational function that is graphed in the xy-plane. Consider $x = 1$ and $x = 7$. The polynomial in the numerator of f has a zero at $x = 1$ and does not have a zero at $x = 7$. The polynomial in the denominator of f has zeros at both $x = 1$ and $x = 7$. The multiplicities of the zeros at $x = 1$ in the numerator and in the denominator are equal.

57. Which of the following statements is true?

(A) The graph of f has holes at both $x = 1$ and $x = 7$.

(B) The graph of f has a vertical asymptote at $x = 1$ and a hole at $x = 7$.

(C) The graph of f has a hole at $x = 1$ and a vertical asymptote at $x = 7$. ✓

(D) The graph of f has vertical asymptotes at both $x = 1$ and $x = 7$.

Answer C

Correct. A real zero in the denominator of a rational function that is not also a real zero in the numerator indicates the graph has a vertical asymptote at $x = 7$. A real zero that has equal multiplicities in both the numerator and denominator indicates a hole in the graph at $x = 1$.

---

58. Which of the following functions has a zero at $x = 3$ and has a graph in the xy-plane with a vertical asymptote at $x = 2$ and a hole at $x = 1$?

(A) $h(x) = \frac{x^2-4x+3}{x^2-3x+2}$ ✓

(B) $j(x) = \frac{x^2-5x+6}{x^2-3x+2}$

(C) $k(x) = \frac{x-3}{x^2-3x+2}$

(D) $m(x) = \frac{x-3}{x^2-4x+3}$

MCQ_Review_Unit_1

Answer A

Correct. The function h equivalent to $\frac{(x-3)(x-1)}{(x-2)(x-1)}$ in factored form. This function has a zero at $x=3$. The graph of the function has a hole at $x=1$ and a vertical asymptote at $x=2$.

59. Which of the following names a function with a hole in its graph at $x=1$ and provides correct reasoning related to the hole?

(A) The graph of $f(x)=\frac{x^2-1}{x-1}$ has a hole at $(1,2)$ because the values of $\frac{x^2-1}{x-1}$ get arbitrarily close to 2 for x-values sufficiently close to 1, but the function is undefined at $x=1$. ✓

(B) The graph of $g(x)=\frac{x^2+1}{x-1}$ has a hole at $x=1$ because the values of $\frac{x^2+1}{x-1}$ increase without bound for x-values arbitrarily close to 1.

(C) The graph of $h(x)=\frac{4x-4}{x^2+1}$ has a hole at $(1,0)$ because the values of $\frac{4x-4}{x^2+1}$ are arbitrarily close to 0 for x-values sufficiently close to 1.

(D) The graph of $k(x)=\frac{4x-4}{(x-1)^2}$ has a hole at $x=1$ because the values of $4x-4$ and $(x-1)^2$ are arbitrarily close to 0 for x-values sufficiently close to 1.

Answer A

Correct. The graph of this function has a hole at $x=1$, at the point with coordinates $(1,2)$, because the limit of the function as x approaches 1 is 2. This can be supported without a calculator by choosing a value close to 1 such as 1.1 and evaluating $\frac{1.1^2-1}{1.1-1}=\frac{1.21-1}{1.1-1}=\frac{0.21}{0.1}$, which is about 2.

60. The rational function g is given by $g(x)=\frac{x^3+1000}{x^2-100}=\frac{(x+10)(x^2-10x+100)}{x^2-100}$. Which of the following statements describes the behavior of the graph of g ?

(A) The graph intersects the x-axis at $x=-10$ because $(-10)^3+1000=0$.

(B) The graph has a hole at $x=-10$ because $(x+10)$ appears exactly once in the numerator and exactly once in the denominator, when both the numerator and the denominator of g are factored. ✓

(C) The graph has vertical asymptotes at $x=10$ and at $x=-10$ because $10^2-100=0$ and $(-10)^2-100=0$.

(D) The graph has no holes because the degree of the numerator is greater than the degree of the denominator.

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Answer B

Correct. Based on the factors of $(x+10)$, the multiplicity (represented by the exponent) of the real zero $x=-10$ in the numerator is greater than or equal to its multiplicity in the denominator, resulting in a hole at the input value of $x=-10$.

61. In the xy-plane, the graph of a rational function f has a vertical asymptote at $x=-5$. Which of the following could be an expression for $f(x)$?

(A) $\frac{(x-5)(x+5)}{2(x-5)}$

(B) $\frac{(x-4)(x+5)}{(x-1)(x+5)}$

(C) $\frac{(x+1)(x+5)}{(x-5)(x+2)}$

(D) $\frac{(x-5)(x-3)}{(x-3)(x+5)}$ ✓

Answer D

Correct. The graph of this rational function has a vertical asymptote at $x=-5$ because -5 is a real zero of the polynomial in the denominator, and is not also a real zero of the polynomial in the numerator.

62. The rational function g is given by $g(x)=\frac{(x^2+3x)(x^2-4x-5)}{(x+3)(x-1)(x-2)}$. For what input values of g are the output values of g equal to 0 ?

(A) 0 only

(B) -1, 0, and 5 only ✓

(C) -3, 1, and 2

(D) -3, -1, 0, and 5

Answer B

Correct. The zeros of the rational function g are the zeros of the numerator that are within the domain of g.

63. The rational function r is given by $r(x) = \frac{x^3+4x^2+4x}{x^2-9}$. On what intervals of x is $r(x) \geq 0$?

(A) $x \geq 0$

(B) $-3 < x < 3$

(C) $-3 < x < -2$, $-2 < x < 0$, and $x > 3$ only

(D) $-3 < x \leq 0$ and $x > 3$ ✓

Answer D

Correct. The real zeros of both the numerator and denominator of the rational function r provide two things: endpoints of intervals on which to determine the behavior of the function and the location of vertical asymptotes of the graph. Points between these zeros are tested to determine the intervals on which the inequality is $r(x) \geq 0$.

64.

x	-8	-4	-2	-1	0	3
$f(x)$	87	55	5	-4	-7	20

The table gives values for a polynomial function f at selected values of x. Let $g(x) = af(bx) + c$, where a, b, and c are positive constants. In the xy-plane, the graph of g is constructed by applying three transformations to the graph of f in this order: a horizontal dilation by a factor of 2, a vertical dilation by a factor of 3, and a vertical translation by 5 units. What is the value of $g(-4)$?

(A) 266

(B) 170

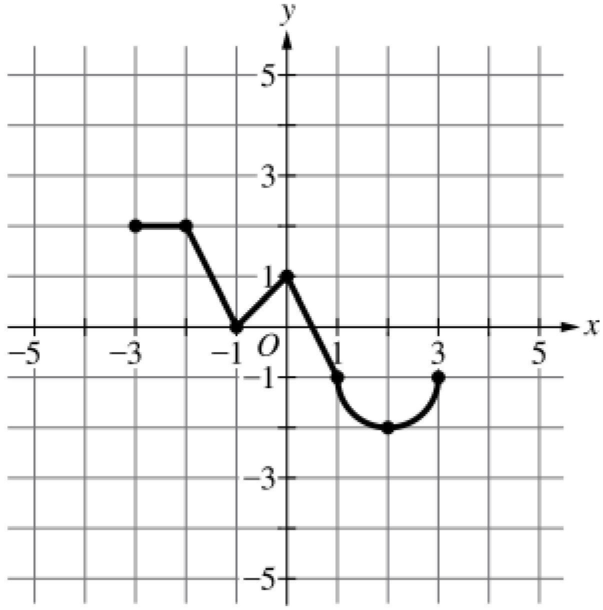
(C) 28

(D) 20 ✓

Answer D

Correct. The combination of transformations results in the function $g(x) = 3f\left(\frac{1}{2}x\right) + 5$, such that $g(-4) = 3f(-2) + 5 = 3(5) + 5 = 20$.

MCQ_Review_Unit_1

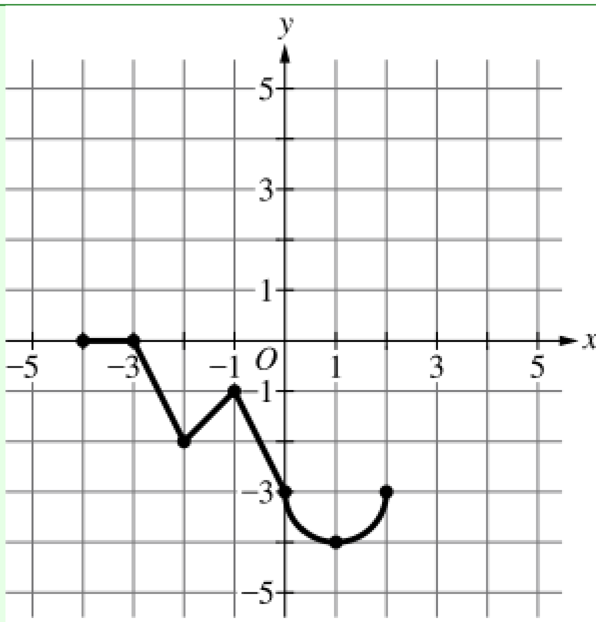


The graph of $y = f(x)$, consisting of four line segments and a semicircle, is shown for $-3 \le x \le 3$.

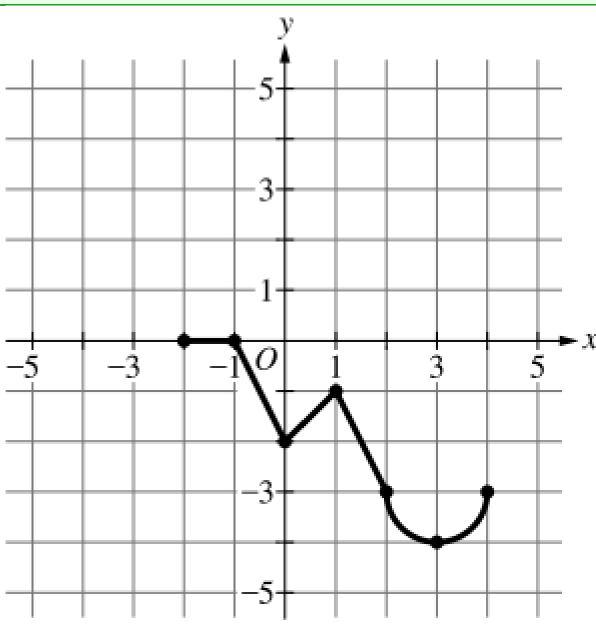
65. Which of the following is the transformed graph for $y = f(x + 1) - 2$?

MCQ_Review_Unit_1

(A)



(B)



(C)

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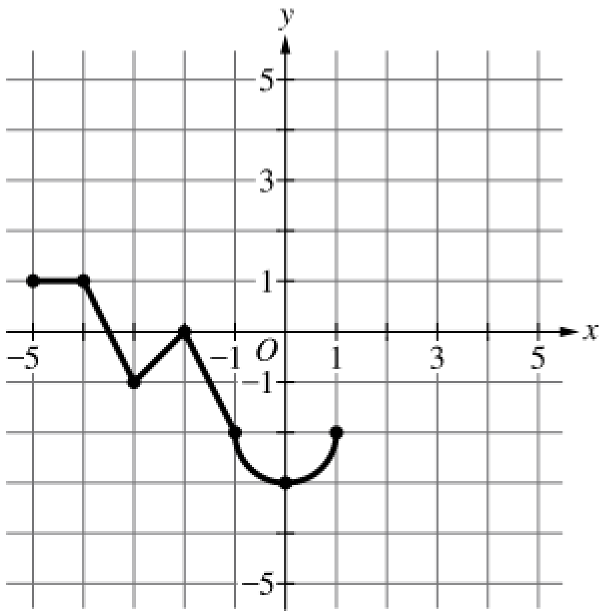
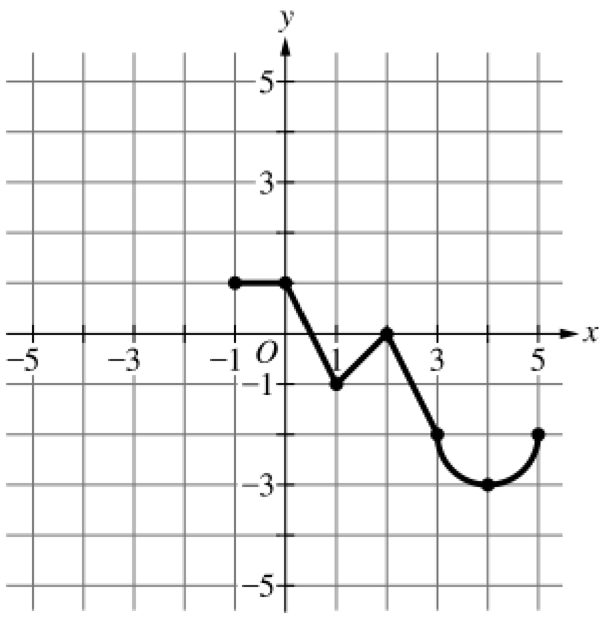


(D)



Answer A

Correct. The additive transformations have been combined to result in a translation of the graph of $y = f(x)$ left 1 unit and down 2 units.

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66. The polynomial function f is given by $f(x) = ax^4 + bx^3 + cx^2 + dx + k$, where $a \neq 0$ and b, c, d, and k are constants. Which of the following statements about f is true?

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(A) f has both a global maximum and a global minimum.

(B) f has either a global maximum or a global minimum, but not both.

(C) f has neither a global maximum nor a global minimum.

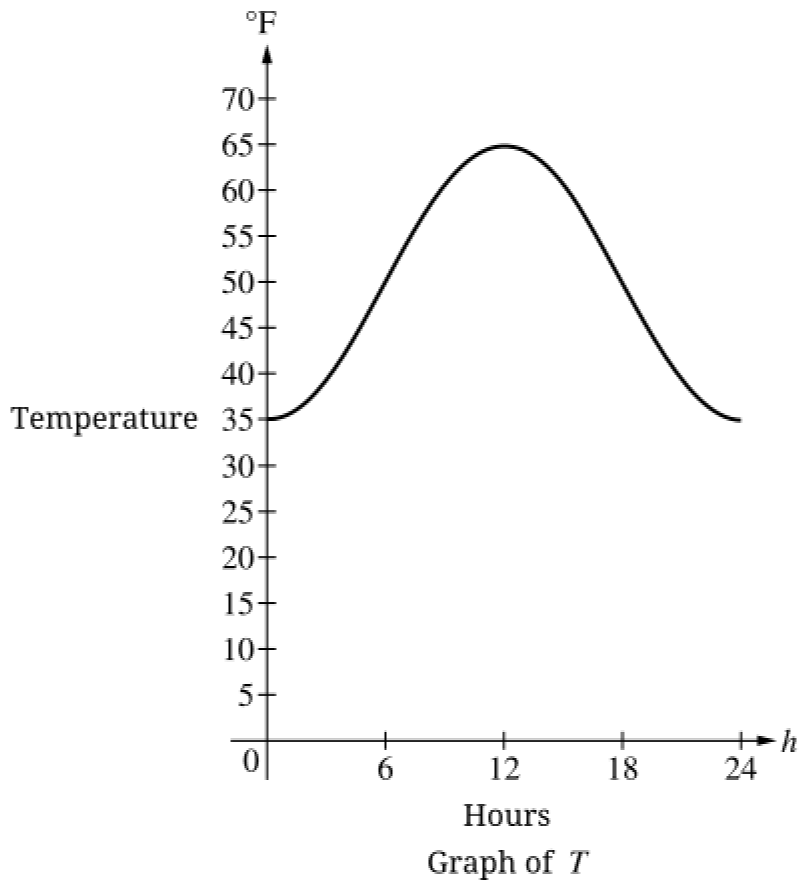
(D) The nature of a global maximum or a global minimum for f cannot be determined without more information about b, c, d, and k.

Answer B

Correct. A polynomial function of even degree, in this case a quartic (degree 4) polynomial, will have either a global maximum or a global minimum.

MCQ_Review_Unit_1

67.



During a month in a certain town, the temperature increases and decreases over the course of a day. A graph of the average temperatures during that month for any given day is shown. The data in the graph can be modeled by the function T, where $T(h)$ gives the temperature, in degrees Fahrenheit ($^\circ$F), at time h hours after midnight. At a certain point in that month, there is an adjustment to clocks for daylight saving time, at which point clocks are adjusted 1 hour forward. For example, 6 a.m. instantly becomes 7 a.m. The function D models the same data as function T, after the shift to daylight saving time. If h still represents the number of hours after midnight, which of the following defines $D(h)$ in terms of T ?

(A) $D(h) = T(h+1)$

(B) $D(h) = T(h-1)$ ✓

(C) $D(h) = T(h) + 1$

(D) $D(h) = T(h) - 1$

Answer B

Correct. To adjust the time for daylight saving time, a horizontal translation is applied to shift the graph right 1 unit.

MCQ_Review_Unit_1

68. The functions f and g are defined for all real numbers such that $g(x) = f(2(x-4))$. Which of the following sequences of transformations maps the graph of f to the graph of g in the same xy-plane?

(A) A horizontal dilation of the graph of f by a factor of 2, followed by a horizontal translation of the graph of f by -8 units

(B) A horizontal dilation of the graph of f by a factor of 2, followed by a horizontal translation of the graph of f by 8 units

(C) A horizontal dilation of the graph of f by a factor of $\frac{1}{2}$, followed by a horizontal translation of the graph of f by -4 units

(D) A horizontal dilation of the graph of f by a factor of $\frac{1}{2}$, followed by a horizontal translation of the graph of f by 4 units ✓

Answer D

Correct. $f(2(x-4))$ is of the form $f(b(x+h))$. This sequence of transformations results in a horizontal dilation of the graph of f by a factor of $\frac{1}{2}$ (compression) because $b=2$, and a horizontal translation (shift) of the graph right 4 units because $h=-4$.

69. The function f is given by $f(x) = x^2 + 2$. The function g is the result of a transformation of f and is given by $g(x) = \frac{x^2}{4} + 2$. Which of the following describes the transformation of the graph of f whose image is the graph of g ?

(A) A vertical dilation by a factor of $\frac{1}{4}$

(B) A horizontal dilation by a factor of $\frac{1}{2}$

(C) A horizontal dilation by a factor of 2 ✓

(D) A horizontal dilation by a factor of 4

Answer C

Correct. The function g is given by $g(x) = f\left(\frac{x}{2}\right)$; therefore, the transformation applied to the graph of f is a horizontal dilation by a factor of 2.

70. The function f has domain $[-2, 2]$ and range $[1, 5]$. The function g is given by $g(x) = -2f(x+3) + 4$. What are the domain and range of g ?

(A) domain: $[-5, -1]$, range: $[-6, 2]$ ✓

(B) domain: $[-5, -1]$, range: $[-2, 6]$

(C) domain: $[1, 5]$, range: $[-2, 6]$

(D) domain: $[1, 5]$, range: $[-6, 2]$

Answer A

Correct. The transformations applied to function f to result in function g, and also to the domain and range, are a horizontal translation left 3 units, a vertical dilation by a factor of $|-2|$ with a reflection over the x-axis, and a vertical translation up 4 units.

71.

x	0	1	2	3	4	5	6	7	8	9	10	11	12
$f(x)$	0	1	4	9	4	1	0	1	4	9	4	1	0
$g(x)$	0	2	2	0	2	2	0	2	2	0	2	2	0

The table gives values of the functions f and g for selected values of x. The pattern of the values of f and g continue, repeating every interval of width 6, for $0 \leq x \leq 48$. The graph of the function g is the result of a sequence of dilations of the graph of the function f. Which of the following could describe those dilations?

(A) A horizontal dilation by a factor of $\frac{1}{3}$ and a vertical dilation by a factor of $\frac{1}{2}$

(B) A horizontal dilation by a factor of $\frac{1}{2}$ and a vertical dilation by a factor of $\frac{1}{3}$

(C) A horizontal dilation by a factor of $\frac{1}{2}$ and a vertical dilation by a factor of $\frac{1}{2}$ ✓

(D) A horizontal dilation by a factor of 3 and a vertical dilation by a factor of 2

Answer C

Correct. The dilations applied to the graph of the function f to transform the function to g are a horizontal dilation by a factor of $\frac{1}{2}$ $(f(2x))$ followed by a vertical dilation by a factor of $\frac{1}{2}$ $(\frac{1}{2}f(2x))$. Therefore, $g(x) = \frac{1}{2}f(2x)$, where $f(x) = f(x+6)$ for $0 \leq x \leq 48$.

MCQ_Review_Unit_1

72. The function f is not explicitly given. In the xy-plane, the graph of the function g is the result of a sequence of transformations to the graph of f. The graph of g is the result of dilating the graph of f vertically by a factor of 2, then horizontally by a factor of 3, then translating the result up by 7 units, and then left by 11 units. Which of the following defines g in terms of f ?

(A) $g(x) = \frac{1}{3}f(2(x-7)) - 11$

(B) $g(x) = \frac{1}{2}f(3(x-11)) - 7$

(C) $g(x) = 2f\left(\frac{x+11}{3}\right) + 7$ ✓

(D) $g(x) = 3f\left(\frac{x+7}{2}\right) + 11$

Answer C

Correct. The additive and multiplicative transformations have been applied appropriately to $f(x)$ to arrive at the intended graph for $g(x)$.

73. The function f is given by $f(x) = x^4 - 3x^2 + 2$. In the xy-plane, the graph of the function g is a vertical translation of the graph of the function f downward by 3 units. Which of the following defines g ?

(A) $g(x) = x^4 - 3x^2 - 1$ ✓

(B) $g(x) = x^4 - 3x^2 + 5$

(C) $g(x) = (x-3)^4 - 3(x-3)^2 + 2$

(D) $g(x) = (x+3)^4 - 3(x+3)^2 + 2$

Answer A

Correct. The function is $g(x) = f(x) - 3$.

MCQ_Review_Unit_1

74.

Interval (in seconds)	0 to 6	6 to 12	12 to 18	18 to 24	24 to 30
Drone A	$+17$	-4	$+11$	-5	-3
Drone B	$+5$	$+3$	$+3$	$+2$	$+3$

Two drones are flying over a given area, and their heights above the ground are changing. The table gives the change in height, in feet, for the drones over successive 6-second intervals. Which of the following is true about the average rates of change for drone A and drone B over the time interval from $t = 0$ seconds to $t = 30$ seconds?

(A) The average rates of change are equal. ✓

(B) The average rate of change for drone A is greater than for drone B.

(C) The average rate of change for drone B is greater than for drone A.

(D) The average rates of change cannot be determined because changes in heights are given, not heights of the drones.

Answer A

Correct. The average rate of change of each drone is found by dividing the total change in height of the drone (both drones change $+16$ feet in height) over the time interval of 30 seconds.

75. The graph of which of the following functions in the xy-plane has at least one x-intercept, at least one hole, at least one vertical asymptote, and a horizontal asymptote?

(A) $f(x) = \frac{x^2-16}{x^2-x-6}$

(B) $f(x) = \frac{x^2-16}{x^2-x-30}$

(C) $f(x) = \frac{x^2-4}{x^2-x-30}$

(D) $f(x) = \frac{x^2-4}{x^2-x-6}$ ✓

MCQ_Review_Unit_1

Answer D

Correct. Rewriting the rational function in factored form $\frac{x^2-4}{x^2-x-6} = \frac{(x-2)(x+2)}{(x-3)(x+2)}$ shows that the graph of the function has one x-intercept at $x = 2$, one hole at $x = -2$, one vertical asymptote at $x = 3$, and a horizontal asymptote at $y = 1$.

The polynomial function k is given by $k(x) = ax^4 - bx^3 + 15$, where a and b are nonzero real constants. Each of the zeros of k has multiplicity 1. In the xy-plane, an x-intercept of the graph of k is $(17.997,0)$. A zero of k is $-0.478 - 0.801i$.

76. Which of the following statements must be true?

(A) The graph of k has three x-intercepts.

(B) $-0.478 + 0.801i$ is a zero of k. ✓

(C) The equation $k(x) = 0$ has four real solutions.

(D) The graph of k is tangent to the x-axis at $x = 17.997$.

Answer B

Correct. Non-real zeros occur in conjugate pairs. If $-0.478 - 0.801i$ is a non-real zero of k, then its conjugate is also a non-real zero of k.

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77. A polynomial function p is given by $p(x) = -x(x-4)(x+2)$. What are all intervals on which $p(x) \geq 0$?

(A) $[-2,4]$

(B) $[-2,0] \cup [4,\infty)$

(C) $(-\infty,-4] \cup [0,2]$

(D) $(-\infty,-2] \cup [0,4]$ ✓

Answer D

Correct. The zeros of the polynomial, $x = -2$, $x = 0$, and $x = 4$, are identified as potential endpoints and are used to determine the intervals that satisfy the polynomial inequality.

MCQ_Review_Unit_1

78. For the polynomial function g, the rate of change of g is increasing for $x < 2$ and decreasing for $x > 2$. Which of the following must be true?

(A) The graph of g has a minimum at $x = 2$.

(B) The graph of g has a maximum at $x = 2$.

(C) The graph of g has a point of inflection at $x = 2$, is concave down for $x < 2$, and is concave up for $x > 2$.

(D) The graph of g has a point of inflection at $x = 2$, is concave up for $x < 2$, and is concave down for $x > 2$.

Answer D

Correct. The rate of change of the polynomial function changes from increasing to decreasing at the input value $x = 2$, resulting in a point of inflection. The graph of the function is concave up on the interval $x < 2$ because the rate of change of the function is increasing. The graph of the function is concave down on the interval $x > 2$ because the rate of change of the function is decreasing.