Warm-Up

Solve each inequality algebraically. *(Lesson 6-7)*

59. $x^2 - 8x + 12 < 0$ **60.** $x^2 + 2x - 86 \geq -23$ **61.** $15x^2 + 3x - 12 \leq 0$

Graph each function. *(Lesson 6-6)*

62. $y = -2(x - 2)^2 + 3$ **63.** $y = \frac{1}{3}(x + 5)^2 - 1$ **64.** $y = \frac{1}{2}x^2 + x + \frac{3}{2}$

Solve each equation by completing the square. *(Lesson 6-4)*

65. $x^2 - 8x - 2 = 0$ **66.** $x^2 + \frac{1}{3}x - \frac{35}{36} = 0$

Notes

POLYNOMIAL FUNCTIONS Recall that a polynomial is a monomial or a sum of monomials. The expression $3r^2 - 3r + 1$ is a **polynomial in one variable** since it only contains one variable, r.

Key Concept *Polynomial in One Variable*

- **Words** A polynomial of degree n in one variable x is an expression of the form $a_0x^n + a_1x^{n-1} + \ldots + a_{n-2}x^2 + a_{n-1}x + a_n$, where the coefficients $a_0, a_1, a_2, \ldots, a_n$, represent real numbers, a_0 is not zero, and n represents a nonnegative integer.
- **Examples** $3x^5 + 2x^4 - 5x^3 + x^2 + 1$
  $n = 5, a_0 = 3, a_1 = 2, a_2 = -5, a_3 = 1, a_4 = 0$, and $a_5 = 1$

Example 1: State the degree and leading coefficient of each polynomial in one variable. If it is not a polynomial in one variable, explain why.

(a) $7x^4 + 5x^2 + x - 9$ (b) $8x^2 + 3xy - 2y^2$

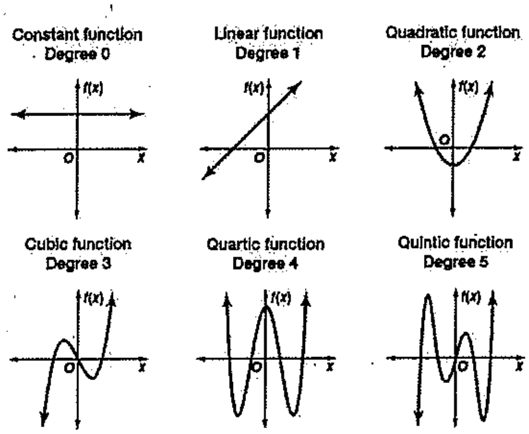
(c) $7x^6 - 4x^3 + \frac{1}{x}$ (d) $\frac{1}{2}x^2 + 2x^3 - x^5$

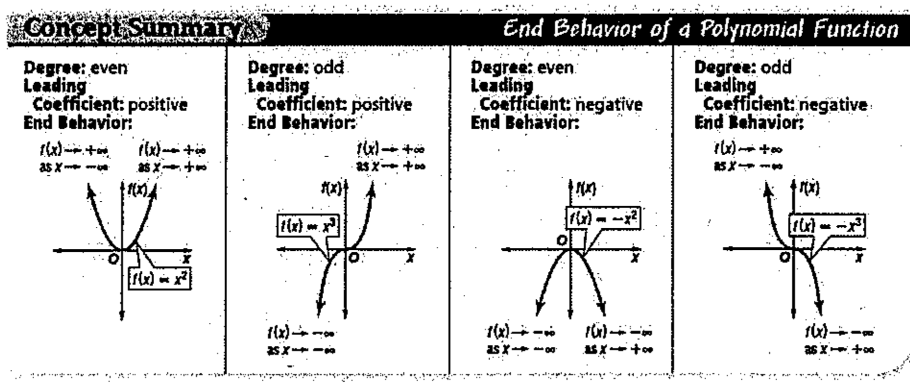
Key Concept *Definition of a Polynomial Function*

- **Words** A polynomial function of degree n can be described by an equation of the form $P(x) = a_0x^n + a_1x^{n-1} + \ldots + a_{n-2}x^2 + a_{n-1}x + a_n$, where the coefficients $a_0, a_1, a_2, \ldots, a_n$, represent real numbers, a_0 is not zero, and n represents a nonnegative integer.
- **Examples** $f(x) = 4x^2 - 3x + 2$
  $n = 2, a_0 = 4, a_1 = -3, a_2 = 2$

Example 2:

(a) Find $p(a^2)$ if $p(x)=x^3+4x^2-5x$ (b) Find $q(a+1)-2q(a)$ if $q(x)=x^2+3x+4$



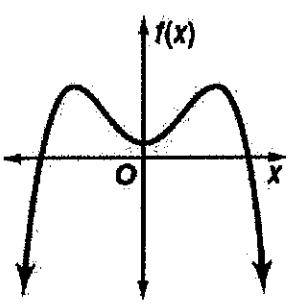


Example 3:

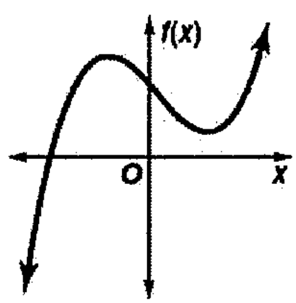
For each graph,

- **describe the end behavior,**
- **determine whether it represents an odd-degree or an even-degree polynomial function, and**
- **state the number of real zeros.**

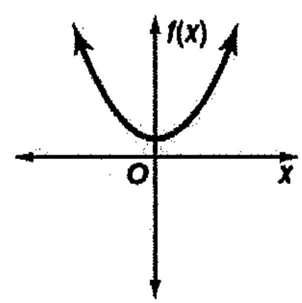
a.



b.



c.



Class work

State the degree and leading coefficient of each polynomial in one variable. If it is not a polynomial in one variable, explain why.

16. $7 - x$

17. $(a + 1)(a^2 - 4)$

18. $a^2 + 2ab + b^2$

19. $6x^4 + 3x^2 + 4x - 8$

20. $7 + 3x^2 - 5x^3 + 6x^2 - 2x$

21. $c^2 + c - \frac{1}{c}$

Find $p(4)$ and $p(-2)$ for each function.

22. $p(x) = 2 - x$

23. $p(x) = x^2 - 3x + 8$

24. $p(x) = 2x^3 - x^2 + 5x - 7$

25. $p(x) = x^5 - x^2$

26. $p(x) = x^4 - 7x^3 + 8x - 6$

27. $p(x) = 7x^2 - 9x + 10$

28. $p(x) = \frac{1}{2}x^4 - 2x^2 + 4$

29. $p(x) = \frac{1}{8}x^3 - \frac{1}{4}x^2 - \frac{1}{2}x + 5$

If $p(x) = 3x^2 - 2x + 5$ and $r(x) = x^3 + x + 1$, find each value.

30. $r(3a)$

31. $4p(a)$

32. $p(a^2)$

33. $p(2a^3)$

34. $r(x + 1)$

35. $p(x^2 + 3)$

36. $2[p(x + 4)]$

37. $r(x + 1) - r(x^2)$

38. $3[p(x^2 - 1)] + 4p(x)$

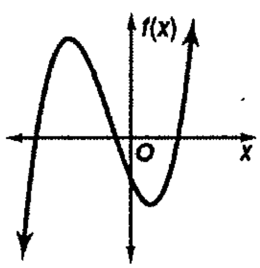
For each graph,

a. describe the end behavior,

b. determine whether it represents an odd-degree or an even-degree polynomial function, and

c. state the number of real zeros.

39.



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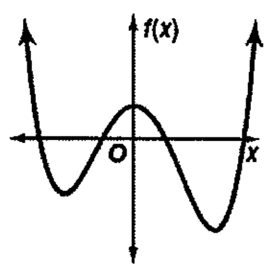

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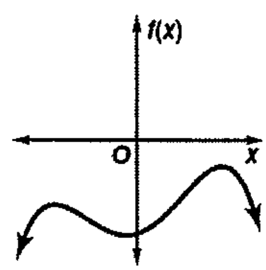

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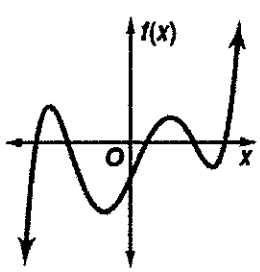

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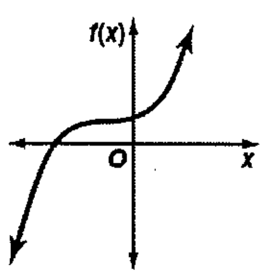

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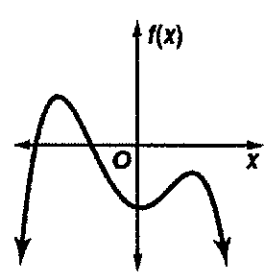


Warm-Up

PREREQUISITE SKILL Find the exact solutions of each equation by using the Quadratic Formula. *(For review of the Quadratic Formula, see Lesson 6-5.)*

60. $x^2 + 7x + 8 = 0$ **61.** $3x^2 - 9x + 2 = 0$ **62.** $2x^2 + 3x + 2 = 0$

Notes

Consider the polynomial function $f(a) = 4a^2 - 3a + 6$. Divide the polynomial by $a - 2$

Key Concept *Remainder Theorem*

If a polynomial $f(x)$ is divided by $x - a$, the remainder is the constant $f(a)$, and

$$\underbrace{f(x)}_{\text{Dividend}} \underbrace{=}_{\text{equals}} \underbrace{q(x)}_{\text{quotient}} \underbrace{\cdot}_{\text{times}} \underbrace{(x-a)}_{\text{divisor}} \underbrace{+}_{\text{plus}} \underbrace{f(a),}_{\text{remainder.}}$$

where $q(x)$ is a polynomial with degree one less than the degree of $f(x)$.

Example 1: If $f(x) = 2x^4 - 5x^2 + 8x - 7$, find $f(6)$

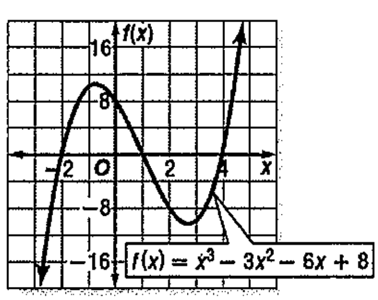
Example 2: Divide $f(x) = x^4 + x^3 - 17x^2 - 20x + 32$ by $x - 4$

When you divide a polynomial by one of its binomial factors, the quotient is called a **depressed polynomial.**

Key Concept *Factor Theorem*

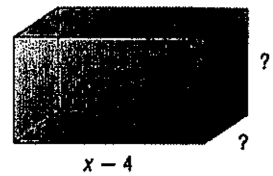
The binomial $x - a$ is a factor of the polynomial $f(x)$ if and only if $f(a) = 0$.

Example 3: Given the graph of the cubic function shown below. find the factors of $f(x)$.



Example 4: Show that $x+3$ is a factor of x^3+6x^2-x-30. Then find the remaining factors of the polynomial.

Example 5: The volume of the rectangular prism is given by $V(x)=x^3+3x^2-36x+32$. Find the missing measures.



Guided Practice

Divide using synthetic division. Is the binomial a factor of the polynomial? Justify your answer.

1) $(x^3-4x^2+2x-6)\div(x-4)$

2) $(x^4-16)\div(x-2)$

Use synthetic substitution to find g(2) and g(-1) for each function.

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

4) $g(x)=x^4-6x-8$

Given a polynomial and one of its factors, find the remaining factors of the polynomial. Some factors may not be binomials.

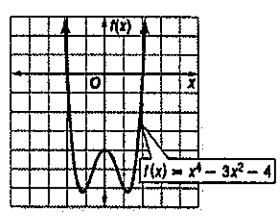
5) $x^3+2x^2-x-2;\quad x-1$

6) $x^3-6x^2+11x-6;\quad x-2$

7) $2x^3+7x^2-53x-28;\quad x+7$

8) $x^4+2x^3+2x^2-2x-3;\quad x+1$

9) Use the graph of the polynomial function at the right to determine at least one binomial factor of the polynomial. Then find all factors of the polynomial.



10) Use synthetic substitution to show that $x-8$ is a factor of $x^3-4x^2-29x-24$. Then find any remaining factors.

Class work: p489 #16, 18, 22, 24, 30, 32, 34, 36, 38, 39

Warm-Up

PREREQUISITE SKILL Factor each polynomial.
(To review factoring polynomials, see Lesson 5-4.)

61. $x^2 - x - 30$ **62.** $2b^2 - 9b + 4$ **63.** $6a^2 + 17a + 5$
64. $4m^2 - 9$ **65.** $t^3 - 27$ **66.** $r^4 - 1$

Notes

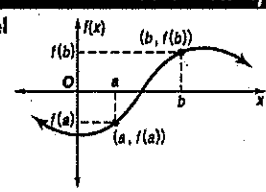
- **relative/absolute maximum, relative/absolute minimum, intervals of increasing and decreasing, x-intercepts/zeros/roots, turning points.**
- **window: x-max, x-min, y-min, y-max**

Example 1: Use a graphing calculator to obtain a complete graph of $f(x) = 2x^3 + 6x^2 - 14x + 12$. Then approximate each real zero to the nearest hundredth.

Example 2: Use a graphing calculator to obtain a complete graph of $f(x) = 3x^5 - 5x^4 - 2x^3 + x^2 - 6x + 8$. Then approximate each real zero to the nearest hundredth.

Key Concept *Location Principle*

- **Words** Suppose $y = f(x)$ represents a polynomial function and a and b are two numbers such that $f(a) < 0$ and $f(b) > 0$. Then the function has at least one real zero between a and b.
- **Model**



A relative maximum occurs when no other nearby points have a greater y-coordinate. A relative minimum occurs when no other nearby points have a lesser y-coordinate.

Example 3: Under certain conditions, the velocity of an object as a function of time is described by the function $V(t) = 9t^3 - 93t^2 + 238t - 120$. Approximate the zeros of V(t) to the nearest tenth and draw the graph.

Warm Up – Solve each by the Quadratic Formula

1) $x^2+x+7=0$ 2) $x^2-x-3=0$ 3) $x^2-x-2=0$

OBJECTIVES

- Write polynomial functions to model real-world data.
- Use polynomial functions to interpret real-world data.

Real World Application

WASTE MANAGEMENT The average daily amount of waste generated by each person in the United States is given below. This includes all wastes such as industrial wastes, demolition wastes, and sewage.

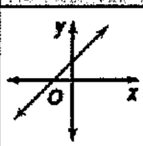
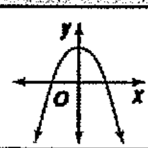
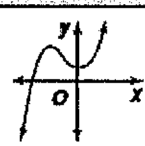
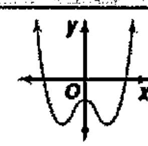
What a Waste!

[illegible]	1980	1985	1990	1991	1992	1993	1994	1995	1996
Pounds of Waste per Person per Day	3.7	3.8	4.5	4.4	4.5	4.5	4.5	4.4	4.3

Source: Franklin Associates, Ltd.

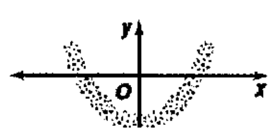
What polynomial function could be used to model these data?

In order to model real world data using polynomial functions, you must be able to identify the general shape of the graph of each type of polynomial function.

Function	Linear $y=ax+b$	Quadratic $y=ax^2+bx+c$	Cubic $y=ax^3+bx^2+cx+d$	Quartic $y=ax^4+bx^3+cx^2+dx+e$
Typical Graph				
Direction Changes	0	1	2	3

Example 1 Determine the type of polynomial function that could be used to represent the data in each scatter plot.

a. 

b. 

Example 2 Use a graphing calculator to write a polynomial function to model the set of data.

x	−1	−0.5	0	0.5	1	1.5	2	2.5	3	3.5	4
$f(x)$	−10	−6.4	−5	−5.1	−6	−6.9	−7	−5.6	−2	4.6	15

Example 3 Real World Application **WASTE MANAGEMENT** Refer to the application at the beginning of the lesson.

a. What polynomial function could be used to model these data?

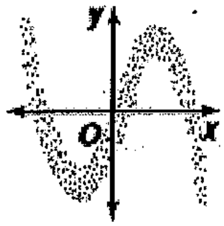
b. Use the model to predict the amount of waste produced per day in 2010.

c. Use the model to predict when the amount of waste will drop to 3 pounds per day.

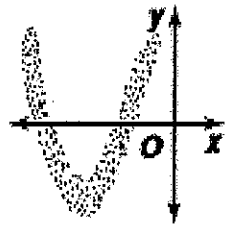
EXERCISES

Determine the type of polynomial function that could be used to represent the data in scatter plot.

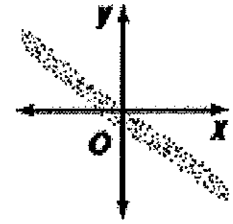
8.



9.



10.



11. What type of polynomial function would be the best model for the set of data?

x	1	2	3	4	5	7	8
$f(x)$	15	7	2	−1	3	10	15

Use a graphing calculator to write a polynomial function to model each set of data.

12.

x	−3	−2	−1	0	1	2	3
$f(x)$	8.75	7.5	6.25	5	3.75	2.5	1.25

13.

x	−2	−1	0	1	2	3
$f(x)$	29	2	−9	−4	17	54

14.

x	−1	−0.5	0	0.5	1	1.5	2	2.5	3	3.5
$f(x)$	13	3	1	2	3	3	1	−1	1	10

19. Marketing The United States Census Bureau has projected the median age of the U.S. population to the year 2080. A fast-food chain wants to target its marketing towards customers that are about the median age.

Year	1900	1930	1960	1990	2020	2050	2080
Median age	22.9	26.5	29.5	33.0	40.2	42.7	43.9

a. Write a model that relates the median age as a function of the number of years since 1900.

b. Use the model to predict what age the fast-food chain should target in the year 2005.

c. Use the model to predict what age the fast-food chain should target in the year 2025.

21. Consumer Credit The amount of consumer credit as a percent of disposable personal income is given below.

Year	1988	1989	1990	1991	1992	1995	1996	1997
Consumer credit	23%	24%	23%	22%	19%	21%	24%	22%

Source: *The World Almanac and Book of Facts*

a. Write a model that relates the percent of consumer credit as a function of the number of years since 1988.

b. Use the model to estimate the percent of consumer credit in 1994.

Warm Up

1) Graph $f(x) = x^3 - 5x + 7$. Identify any relavitve/absolute maximum and minimum. Identify the intervals of increasing and decreasing. State the number of turning points. Find the x-intercepts.

Notes

Fundamental Theorem of Algebra – Every polynomial with degree greater than zero has at least one root in the set of complex numbers. In other words, a polynomial equation of the form P(x) = 0 of degree n with complex coefficients has exactly n roots in the set of complex numbers.

Example 1 - Find all roots of $0 = x^3 + 3x^2 - 10x - 24$ if 3 is one zero of f(x).

Complex Conjugates Theorem - Suppose a and b are real numbers with $b \neq 0$. If a + bi is a zero of a polynomial function, then a – bi is also a zero of the function.

Example 2 – Find all zeros of $f(x) = x^3 - 5x^2 - 7x + 51$ if $4 - i$ is one zero of f(x).

Descartes Rule of Signs – If P(x) is a polynomial function whose terms are arranged in descending powers of the variable,

- The number of positive real zeros of P(x) is the same as the number of changes in sign of the coefficients of the terms, or is less than this by an even number, and
- The number of negative real zeros of P(x) is the same as the number of changes in sign of the coefficients of the terms of P(-x), or is less than this by an even number.

Example 3 – State the number of positive and negative real zeros for $p(x) = 4x^5 + 3x^4 - 2x^3 + 5x^2 - 6x + 1$

Example 4 – Write the polynomial function of least degree with integral coefficients whose zeros include 7 and $3+2i$.

Guided Practice

State the number of positive real zeros, negative real zeros, and imaginary zeros for each function

1) $f(x)=x^3-6x^2+1$

2) $f(x)=x^4+5x^3+2x^2-7x-9$

Given a function and one of its zeros, find all the zeros of the function.

3) $h(x)=x^3-6x^2+10x-8;\quad 4$

4) $g(x)=x^3+6x^2+21x+26;\quad -2$

5) $f(x)=x^3+7x^2+25x+175;\quad 5i$

6) $p(x)=x^4-9x^3+24x^2-6x-40;\quad 3-i$

Write the polynomial function of least degree with integral coefficients that has the given zeros.

7) -4, 1, 5

8) 9, 1 + 2i

Class work – p507 #18, 20, 22, 24, 25, 26, 28, 35, 26, 37

Warm Up

1) Write a polynomial function of least degree with integral coefficients that has -2 and 2 + 3i as zeros.

Notes

Rational Zero Theorem – Let $f(x) = a_0x^n + a_1x^{n-1} + ... + a_{n-1}x + a_n$ represent a polynomial function with integral coefficients. If $\frac{p}{q}$ is a rational number in simplest form and is a zero of y = f(x), then p is a factor of a_n and q ia a factor of a_0 .

Example 1 - List all possible rational zeros of $f(x) = 3x^3 + 9x^2 + x - 10$, and state whether they are positive or negative.

Example 2 – The volume of a rectangle solid is 1430 cubic centimeters. The width is 1 centimeter less than the length, and the height is 2 centimeters greater than the length. Find the dimensions of the solid.

Example 3 – Find all zeros of $f(x) = 4x^4 - 13x^3 - 13x^2 + 28x - 6$

Guided Practice

List all of the possible rational zeros for each function.

1) $h(x) = x^3 + 8x^2 + 6$

2) $d(x) = 6x^3 + 6x^2 - 15x - 2$

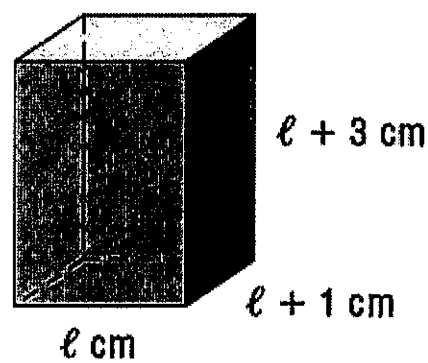
Find all of the rational zeros for each function.

3) $f(x) = x^3 - x^2 - 34x - 56$

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

5) Write a polynomial function of least degree that has zeros -3, 2, and 5.

6) The volume of the figure at the right is 1430 cm^3. Find the dimensions.



Class work – p513 #16, 22, 23, 34

Warm Up

1) Write a polynomial function of least degree with integral coefficients that has 3, 2i, -2i as zeros.

Notes

Definition of Quadratic Form (Not necessarily a quadratic function) – For any numbers a, b, and c except a = 0, an equation that can be written as $a[f(x)]^2 + b[f(x)] + c = 0$, where f(x) is some expression in x, is in quadratic form.

Example 1 - Solve $x^4 - 17x^2 + 16 = 0$

Example 2 – Solve $x^3 + 64 = 0$

Example 3 – Solve $1046 = 1000x^{\frac{2}{3}}$

Example 4 – Solve $x^{\frac{1}{2}} - 8x^{\frac{1}{4}} + 15 = 0$

Example 5 – Solve $x - 2\sqrt{x} - 3 = 0$

Guided Practice

Solve each equation

1) $x - 16x^{\frac{1}{2}} = -64$

2) $m^4 + 7m^3 + 12m^2 = 0$

3) $3m^{\frac{3}{2}} - 81 = 0$

4) $y^3 = 26.6y - 3.2y^2$

Class work – p518 #23-28

Warm Up

Retail - Sara Sung is shopping and finds several items that are on sale at 25% off the original price. The items that she wishes to buy are a sweater originally at \$43.98, a pair of jeans for \$38.59, and a blouse for \$31.99. She has \$100 that her grandmother gave her for her birthday. If the sales tax in San Mateo, California, where she lives is 8.25%, does Sara have enough money for all three items? Explain

---

Composition of Functions – If f and g are functions, then the composite function $g \circ f$, or composition of g and f is defined by $g \circ f = g(f(x))$. We read g(f(x)) as "g of f of x."

Example 1: Let $f(x) = x^2 + 3x + 2$ and $g(x) = \frac{1}{x}$

(a) Evaluate $(f \circ g)(2)$ and $(g \circ f)(2)$. How do they compare?

(b) Find the composite functions defined by $(f \circ g)(x)$ and $(g \circ f)(x)$. Are they equivalent expressions?

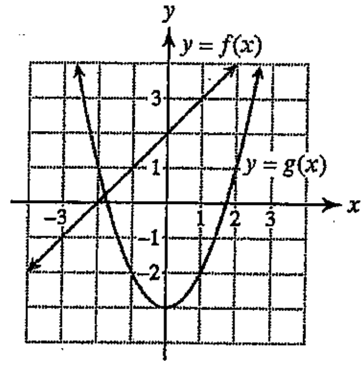
Example 2: Find $(f \circ g)(x)$ and $(g \circ f)(x)$.

(a) $f(x) = \sqrt{2x}$ $g(x) = \frac{1}{x+1}$

(b) $f(x) = 2x - 3$ $g(x) = x^2 + 5$

Example 3: Use the graphs of f and g shown in the graph below. Evaluate each expression.

(a) $(f \circ g)(2)$ (b) $(g \circ f)(-3)$ (c) $(f \circ f)(-3)$



Example 6: Depletion of the ozone layer can cause an increase in the amount of UV radiation reaching the surface of Earth. An increase in UV radiation is associated with skin cancer. In the table below, the function f computes the approximate percent increase in UV radiation resulting from an x percent decrease in the thickness of the ozone layer. The function g shown in the table below computes the expected percent increase in cases of skin cancer resulting from an x percent increase in UV radiation.

Percent Increase in UV Radiation							
X	0	1	2	3	4	5	6
f(x)	0	1.5	3.0	4.5	6.0	7.5	9.0

Percent Increase in Skin Cancer							
x	0	1.5	3.0	4.5	6.0	7.5	9.0
g(x)	0	5.25	10.5	15.75	21.0	26.25	31.5

(a) Find $(g \circ f)(2)$ and interpret this calculation.

(b) Create a table for $g \circ f$. Describe what $(g \circ f)(x)$ computes.

Class work: p524 #19-36

Warm Up

1) Write the slope-intercept form of the equation of the line that passes through points at (0, 7) and (5, 2).

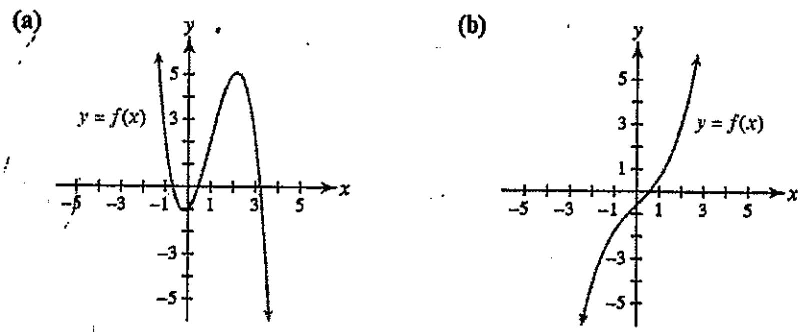
Inverse Operations & Inverse Functions – In mathematics there are basic operations that can be considered inverse operations. Addition and subtraction are inverse operations. The same is true for multiplication and division.

One-to-One Functions – Not every function has an inverse function, as seen in next example.

Example 1: The table below represents a function C that computes the percentage of the time that the sky is cloudy in Augusta, Georgia, where x corresponds to the standard numbers for the months. Determine if C has an inverse function.

Cloudy Skies in Augusta												
x(month)	1	2	3	4	5	6	7	8	9	10	11	12
C(x) %	43	40	39	29	28	26	27	25	30	26	31	39

Example 2: Use each graph to determine if f is one-to-one and if f has an inverse function.



Horizontal Line Test – If every horizontal line intersects the graph of a function f at most once, then f is a one-to-one function. In other words, the inverse is also a function.

Inverse Function - Let f be a one-to-one function. Then f^{-1} is the inverse function of f if

$$(f^{-1} \circ f)(x) = f^{-1}(f(x)) = x$$
$$(f \circ f^{-1})(x) = f(f^{-1}(x)) = x$$

Example 3: Let f be the one-to-one function given by $f(x) = x^3 - 2$.

(a) Find a formula for $f^{-1}(x)$

(b) Identify the domain and range of f^{-1}.

(c) Verify that your result form part (a) is correct.

Example 4: The function $f(x) = \frac{3}{4}x + 39$ gives the percentage of China's population that may live in urban areas x years after 2000, where $0 \le x \le 40$.

(a) Explain why f is a one-to-one function

(b) Find a formula for $f^{-1}(x)$

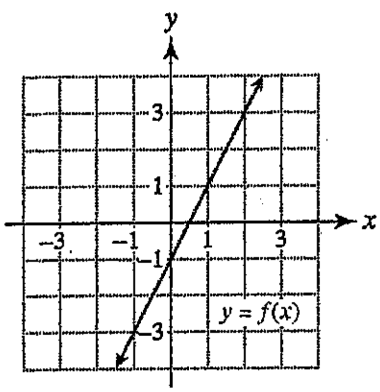
(c) Evaluate and interpret the meaning of $f^{-1}(60)$

Domains & Ranges of Inverse Functions – The domain of f equals the range of f^{-1}. The range of f equals the domain of f^{-1}.

Graphs of Functions and Their Inverse–The graph of f^{-1} is a reflection of the graph of f across the line y = x

Example 7: Let $f(x) = x^3 + 2$. Graph f. Then sketch a graph of f^{-1}.

Example 8: Use the graph of f below to evaluate each expression. (a) f(2) (b) $f^{-1}(3)$ (c) $f^{-1}(-3)$



Example 9: Use the table below to evaluate each expression: (a) f(2) (b) $f^{-1}(3)$ (c) $f^{-1}(-3)$

x	f(x)
1	3
2	5
3	7
7	-3

Class work: p532 #15-34

Directions: Answer the following question(s).

1 Given the table for $f(x)$ below, find $f^{-1}(3)$

x	f(x)
1	3
2	5
3	7
7	-3

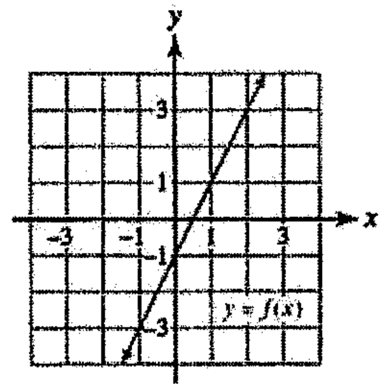
A. 1

B. 7

C. 5

D. -3

2 Given the graph of $f(x)$ below, find $f^{-1}(3)$



A. 2

B. 5

C. -1

D. -3

3 Which of the following functions has an end behavior in which the following occurs:
As $x \to -\infty$, $g(x) \to -\infty$ and
as $x \to \infty$, $g(x) \to \infty$?

A. $g(x) = \frac{4}{3}x^3 + 7$

B. $g(x) = -\frac{1}{3}x^5 + 2$

C. $g(x) = 0.19x^4 - 4$

D. $g(x) = -0.25x^8 + 1$

Directions: Answer the following question(s).

4 Given $f(x) = (x-3)^3 + 4$, find $f^{-1}(x)$.

A. $f^{-1}(x) = \sqrt[3]{x-4} + 3$

B. $f^{-1}(x) = \sqrt[3]{x+4} - 3$

C. $f^{-1}(x) = \sqrt[3]{x-3} + 4$

D. $f^{-1}(x) = \sqrt[3]{x+3} - 4$

5 Which of the following expressions represents a polynomial in one variable which has a degree of 4 and a lead coefficent of -2?

A. $4x^2 + 6x + 7$

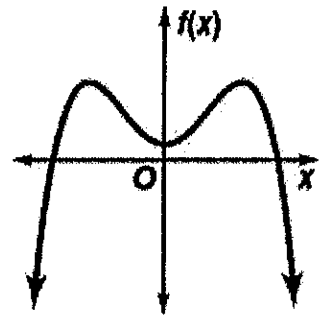
B. $6x^2 - 2x^4 + 1$

C. $2x^6 + 2x^4 - 1$

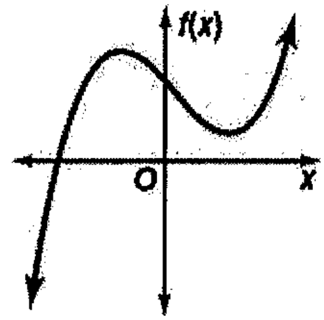
D. $-2x^4 + x + 2 - 7x^5$

6 Which of the following graphs represents a polynomial function with a negative leading coefficient and odd degree?

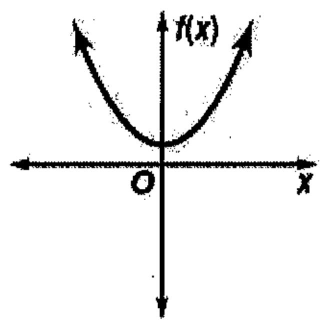
A.



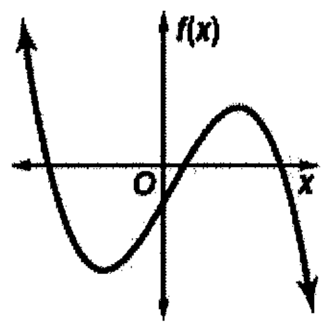
B.



C.

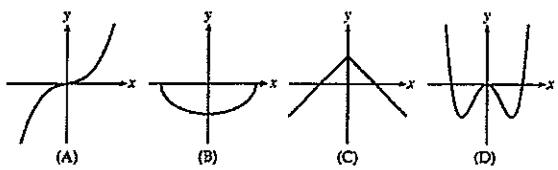


D.



Directions: Answer the following question(s).

7 Determine which graph(s) is/are one-to-one function?



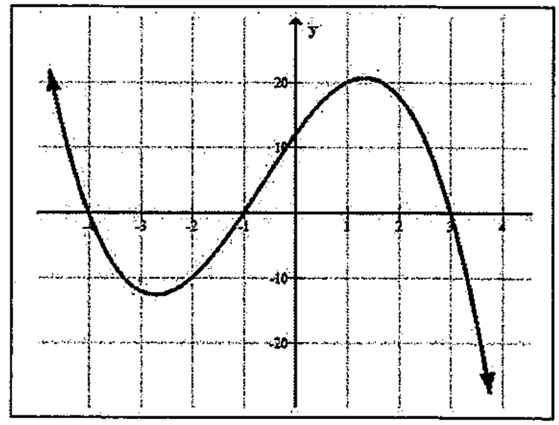
A. A only

B. B only

C. C only

D. All of the graphs

8 Write the complete factored form of the polynomial in the graph below. The leading coefficient is either 1 or -1 and has integer zeros.



A. $y = (x-4)(x-1)(x+3)$

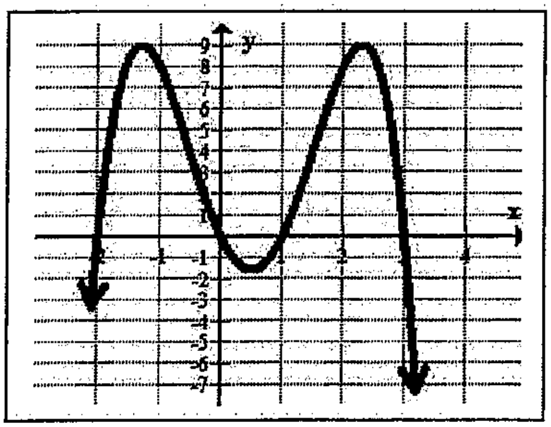
B. $y = -(x-4)(x-1)(x+3)$

C. $y = (x+4)(x+1)(x-3)$

D. $y = -(x+4)(x+1)(x-3)$

Directions: Answer the following question(s).

9 Below is the graph of a polynomial function. Which statement is true?



A. The leading coefficient is positive.

B. There is a zero at x = 4.

C. The minimum degree of the polynomial is 4.

D. There are four turning points in this polynomial.

10 Let $f(x)$ compute the time in hours to travel x miles at 52 miles per hour. What does $f^{-1}(x)$ compute?

A. The miles traveled in x hours at 52 miles per hour.

B. The hours to travel x miles.

C. The hours to travel 52 miles.

D. The hours it took to travel 52 miles.

11 Let $f(x) = 7x - 5$, find $f^{-1}(x)$.

A. $f^{-1}(x) = 7x - 12$

B. $f^{-1}(x) = \frac{x+5}{7}$

C. $f^{-1}(x) = \frac{1}{7x-5}$

D. $f^{-1}(x) = \frac{x-5}{7}$

12 Use the table to evaluate $(f \circ g)(1)$.

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

A. -3

B. 0

C. 4

D. 2

Directions: Answer the following question(s).

13 Using a graphing calculator, approximate the real zeros of the following function to the nearest tenth.

$$f(x) = x^5 - 7x^4 - 3x^3 + 2x^2 - 4x + 9$$

A. $\{-1.3, 0.9, 7.4\}$

B. $\{1.3, 0.9, 7.4\}$

C. $\{1.3, -0.9, -7.4\}$

D. $\{-1.3, -0.9, -7.4\}$

14 Write a polynomial of least degree which has the following set of roots: $\{-3i, 3i, 2\}$

A. $x^3 + 2x^2 + 9x + 18$

B. $x^3 + 2x^2 - 9x - 18$

C. $x^3 - 2x^2 + 9x - 18$

D. $x^3 + 2x^2 - 6x - 12$

15 Given $g(x) = x^3 + 3x^2 - 9x$, determine the intervals for which $g(x)$ is increasing.

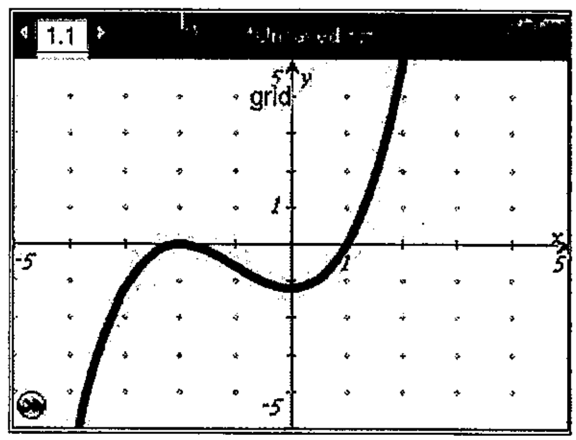
A. $(-\infty, -3) \cup (1, \infty)$

B. $(-\infty, \infty)$

C. $(-\infty, 27) \cup (-5, \infty)$

D. $(-\infty, \infty) \cup (1, \infty)$

16 Given the graph of h(x) below, determine the interval(s) in which h(x) is increasing.



A. $(-\infty, -2) \cup (0, \infty)$

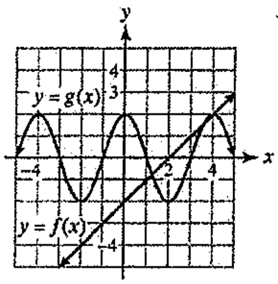
B. $(-\infty, 0) \cup (-1, \infty)$

C. $(-\infty, \infty)$

D. $(-\infty, 0)$

Directions: Answer the following question(s).

20 Use the graph to evaluate $(f \circ g)(2)$



A. -4

B. 2

C. -2

D. 8