Mathematics in Action Algebraic Graphical and Trigonometric Problem Solving 5th edition Consortium for Foundation Mathematics Solutions Manual

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SECTION 2 CHAPTER NOTES

These notes provide a brief description of the theme and focus of the individual Activities in the textbook. We have tried to share with you many of our classroom experiences with this material, including areas you might wish to emphasize and questions with which many students encounter difficulty. However, the best advice we can give you is to read carefully each activity before class. You will certainly have your own ideas on how best to explore a given topic with your class – as a whole class activity, in peer groups, or in pairs. You may also anticipate conceptual or computational difficulties and choose to head them off by addressing them first in a pre-activity discussion or in a supplemental question, worksheet, or assignment. Your students will be best served when you work in partnership with the text, permitting your own emphasis and enthusiasm to help guide their discovery.

CHAPTER 1 FUNCTION SENSE

You may want to discuss the objectives of the course with your students on the first day of class. When you give the students your course outline, you may want to include a section on the structure of the course. The preface of the text also explains the nature of the course. Students should know that they will be actively learning; that lecture will be at a minimum; that teamwork is stressed; that technology will be used; and that the book is a collection of activities that relate to the world around them. They should know that problem solving and critical thinking skills are practiced throughout the course. Skills are introduced as they are needed in each activity.

CLUSTER 1 MODELING WITH FUNCTIONS

Activity 1.1 Parking Problems

Objectives:

1. Identify input and output in situations involving two variable quantities.
2. Identify a functional relationship between two variables.
3. Identify the independent and dependent variables.
4. Use a table to numerically represent a functional relationship between two variables.
5. Write a function using function notation.

This is a great activity to begin with since most students do have a parking problem on their campus. They can relate to the number of cars in the lot at any given time. To help the students become acquainted, you may want to ask them to form groups of three or four. Ask them to introduce themselves and begin reading the activity. It is important that they do the work together rather than individually within the group. They should discuss each question together to arrive at the best answer. As you walk around the room, you will see that some groups are on their way while others struggle, especially with the concept of a function. You may want to stop after Problem 3 and discuss the concept of a function in a whole class discussion. Example 2 will help with your discussion. You may have to give a few more examples of functions as models. Emphasize that the output is a function of the input. Groups, working together, can do Problems 4 and 5. You will need to stop and listen and question. Reinforcement of function notation will be necessary in Example 5. Problem 10 ties this activity together and may be completed in groups. Vocabulary words such as function, variable, input, output, ordered pair and how they relate must be understood. Thinking of examples of functions is the most difficult part of the exercises for the students.

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At the beginning of the next class period you may want to give each group an index card to write one example of a function defined verbally from Exercise 11. This begins your next class with group discussions to determine which student's example will be used on the card and offers you the opportunity to reinforce the concept of a function by discussing with the whole class whether each group's choice was a good one.

Activity 1.2 Fill'er Up

Objectives:
1. Determine the equation (symbolic representation) that defines a function.
2. Determine the domain and range of a function.

To begin this activity, you may want to ask students to gather in the same groups or you may want them to meet more students in the class. All students may not have purchased or borrowed a calculator by this class period. Ask them to form groups making sure there is at least one person in their group who has the graphing calculator. A general introduction to the calculator may be necessary to show students how to input fractions, use the parentheses, the negative sign and the exponent. A whole class discussion and calculator demonstration using the cost of a fill up as the model and introducing the calculator to create a table works well in this activity. The function notation is expanded when writing the relationship between two variables in symbolic form. Students will need help in the transition to function notation in Problem 5. The difference between domain and practical domain and range and practical range should be clear to the student. Representing the domain and range using inequality notation and/or brackets/parentheses should be noted. Problem 11 ties the activity together and can easily be completed in groups. The emphasis is on the numerical and the symbolic form of the representation of a function.

Activity 1.3 Graphically Speaking

Objectives:
1. Represent a function verbally, symbolically, numerically, and graphically.
2. Distinguish between a discrete function and a continuous function.
3. Graph a function using technology.

The focus in this activity is the graphical representation of the function. Students should be able to do Problems 1-3 in groups. Scaling should be reviewed as they graph the data points in Problems 1 and 3. Ask the students if the points should be connected to form a line on the graph. A discussion of discrete versus continuous functions is appropriate here. This will be the first time for many students to use the graphing calculator to set a window and graph the function. Students will need help in setting an appropriate window for the data given. This activity will give you the opportunity to summarize Activities 1.1-1.3 on representing a function verbally, numerically, symbolically, and graphically.

Activity 1.4 Stopping Short

Objectives:
1. Use a function as a mathematical model.
2. Determine when a function is increasing, decreasing, or constant.
3. Use the vertical line test to determine whether a graph represents a function.

A whole class discussion of the definition of a math model is important. The trace feature of the graphing calculator is explored to determine an exact value of an input. If the window is not defined or a table is not given (Exercises 6 and 7), students have difficulty in setting the window for the function. Increasing and decreasing and constant functions can be completed in groups. A class discussion about the vertical line test with examples provides reinforcement of this concept.

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Activity 1.5 Graphs Tell Stories

Objectives:
1. Describe in words what a graph tells you about a given situation.
2. Sketch a graph that best represents the situation described in words.
3. Identify increasing, decreasing, and constant parts of a graph.
4. Identify minimum and maximum points on a graph.

This activity works well as a group project. Together, you may want to do Example 1 at the beginning of the activity. To test their communication skills after they have spent time in groups completing the activity, assign one question per group and give them a few minutes to decide who will speak for the group or if each person will have a part. Have them go to the front of the class and explain to the class their problem. You may want to give points as a group grade for the presentation. Include communication skills as part of the grade. If you give them until the next class before presenting, you may have a better product. Students should be able to describe the increasing and decreasing and constant parts of these functions as well as point out any minimum or maximum points.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

CLUSTER 2 LINEAR FUNCTIONS

Activity 1.6 Walking for Fitness

Objective:
1. Determine the average rate of change.

Students are able to complete this activity easily with their group. The notation for rate of change as well as the concept of rate of change should be discussed with the whole class. Students will question whether to leave the rate of change with a denominator of 1 or the original denominator.

Activity 1.7 Depreciation

Objectives:
1. Interpret slope as an average rate of change.
2. Use the formula to determine slope.
3. Discover the practical meaning of vertical and horizontal intercepts.
4. Develop the slope-intercept form of an equation of a line.
5. Use slope-intercept formula to determine vertical and horizontal intercepts.
6. Determine the zeros of a function.

Students will have questions as they progress through this activity with their group, but for many it is a review from high school or a previous college course and someone in the group usually can help. It is important that the student understands the concept of slope as a rate of change. Many students have never thought about the practical meaning of the slope and vertical intercept in a contextual setting. An explanation of why we use the words vertical and horizontal intercept rather than x and y intercept is appropriate in this activity. The slope-intercept form of a linear equation is easily applied in Problems 7-8. Problem 11 will test the students' understanding of the concepts in this activity. In the skills section of this guide there is a review worksheet on solving linear equations and inequalities.

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Activity 1.8 A New Camera

Objectives:
1. Write a linear equation in the slope-intercept form given the initial value and the average rate of change.
2. Write a linear equation given two points, one of which is the vertical intercept.
3. Use the point-slope form to write a linear equation given two points, neither of which is the vertical intercept.
4. Compare slopes of parallel lines.

In this activity students will determine the equation of a line using the slope-intercept form, $y = mx + b$. This equation may be determined directly from the graph of the linear function or the student may be given the slope and vertical intercept or just two points. When students do Problems 5-7, finding the equation of a line given two points with neither of the points containing the vertical intercept, the student may need more direction. You may also want to review sketching graphs of linear functions given the slope and a point.

Activity 1.9 Skateboard Heaven

Objectives:
1. Write an equation of a line in general form $Ax + By = C$.
2. Write the slope-intercept form of a linear equation given the general form.
3. Determine the equation of a horizontal line.
4. Determine the equation of a vertical line.

The purpose of this activity is to show linear equations in general form and to change them from general form to slope-intercept form. Once students realize that the symbolic form of a linear function is not always presented or created in the slope-intercept format, but often in general form $(Ax + By = C)$, then students recognize the skill needed to change these general forms into the slope-intercept form. The value of the slope-intercept form for entering into your graphing calculator and the ability to do a quick sketch using slope and vertical intercept should be noted. Equations of vertical and horizontal lines and their slopes complete this activity. Students may not make the distinction between a zero slope and an undefined slope.

Activity 1.10 College Tuition

Objectives:
1. Recognize when patterns of points in a scatterplot have a linear form.
2. Recognize when the pattern in the scatterplot shows that the two variables are positively related or negatively related.
3. Estimate and draw a line of best fit through a set of points in a scatterplot.
4. Use a graphing calculator to determine a line of best fit by the least-squares method.
5. Measure the strength of the correlation (association) by a correlation coefficient.
6. Recognize that a strong correlation does not necessarily imply a linear or a cause-and-effect relationship.

You may want to begin this activity with an overview of the meaning of regression and line of best fit. To save time you may want to discuss Problems 1, 2, and 3 together. As you do Problems 4 and 5, you may want to group students with like calculators together and provide handouts on regression if they do not have the TI-84 Plus C graphing calculator. A discussion of forecasting and interpolation and extrapolation should also take place. Problem 7 is another example the students could do in their groups to determine a regression model. You may want to discuss with the whole class the strength of the linear relationship between the two variables. This activity may take two class periods.

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WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

These sections provide an excellent review of the material in this cluster. Problems may be assigned for homework or for a group review before an exam.

CLUSTER 3 SYSTEMS OF LINEAR EQUATIONS, INEQUALITIES, AND ABSOLUTE VALUE FUNCTIONS

Activity 1.11 Moving Out

Objectives:
1. Solve a system of 2×2 linear equations numerically and graphically.
2. Solve a system of 2×2 linear equations using the substitution method.
3. Solve an equation of the form $ax + b = cx + d$ for x.

Students seem to relate to this activity because they have worked with systems successfully in the past. Use the graphing calculator to determine the solution numerically from the table and also determine the solution from the graph. This will be easy for the students to do in groups. The visual reinforcement helps the student make connections with the algebraic skill. You may want to model the algebraic skill (method of substitution). Students find this more difficult than the addition method. The activity flows rather well for them and they can complete it for homework.

Activity 1.12 Fireworks

Objectives:
1. Solve a 2×2 linear system algebraically using the substitution method and the addition method.
2. Solve equations containing parentheses.

The focus of this activity is on the algebraic method of solving 2×2 systems of linear equations. The substitution method is revisited and the addition method is modeled. Students should successfully complete this activity in groups.

Activity 1.13 Manufacturing Smartphones

Objective:
1. Solve a 3×3 linear system of equations.

The major goal of this activity is not only to teach students how to solve a 3×3 linear system algebraically, but just as importantly, give them a reason for doing so. The scenario of manufacturing smartphones may not be super realistic, but it is not far from being plausible. Obviously the numbers have been "cooked" to lead to nice round results, but the set-up of the equations is the real key. Students will need guidance as they struggle with forming three equations. You may want to emphasize that each of the three statements will lead to a single equation. Problem 10-12 may be completed in groups with some guidance from the instructor.

The assumption throughout this activity is that students have solved 2×2 linear systems, and that students should draw on their prior experience. The instructor should at least remind the class of this, if not also to model such a 2×2 system's algebraic solution.

Activity 1.14 Earth Week

Objective:
1. Solve a linear system of equations using matrices.

This activity is a nice extension of Activity 1.13. Students should be able to create a 3×3 system from a real life situation. Now they will learn how to represent the system using matrices. Students are shown how to solve a 2×2 system using matrices, but students would need more than one class session to become an expert in doing this algebraically. The goal is to use the graphing calculator to solve these matrices. This activity should be straightforward and completed in one class session.

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Activity 1.15 How Long Can You Live?

Objectives:
1. Solve linear inequalities in one variable numerically and graphically.
2. Use properties of inequalities to solve linear inequalities in one variable algebraically.
3. Solve compound inequalities algebraically.
4. Use interval notation to represent a set of real numbers described by an inequality.

Most students probably have not solved inequalities numerically or graphically. This is a nice opportunity to help the students connect visually with an algebraic skill that may be familiar. The model of life expectancies for men and women provides a contextual situation for a whole class discussion on inequalities. The algebraic approach may require a little help, but working in groups here will reinforce the skill. The student will also learn how to graph on the number line with open/closed circle notation. Students should be able to write inequalities using interval notation.

Activity 1.16 Working Overtime

Objectives:
1. Graph a piecewise linear function.
2. Write a piecewise linear function to represent a given situation.
3. Graph a function defined by $y = |x - c|$.

The focus in this activity is on piecewise functions. Give your groups a chance to read and react to Problems 1 and 2. Then have a class discussion to complete Problems 3-4. In Problems 5-6 students should be able to complete in groups. You may want to show students how to graph these piecewise functions using the graphing calculator. Demonstrate how to access inequality signs and enter a piecewise function. Problems 7-12 can be done in groups and should reinforce the concepts learned. Students still may need some guidance as they approach these real life situations. Again, have a class discussion showing the result of this piecewise function and the calculator display. You may want to model a problem to demonstrate using open and closed circles for where the function exists and does not exist as in number 2 of the exercise section.

The absolute value function is a great extension to the piecewise activity. A class discussion, on shifts of the graphs of absolute value functions and how the shifts affect the equations of the function as well as determining the domain and range, is appropriate here.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

If the students need more practice there are skills worksheets on linear equations and linear inequalities and also absolute value inequalities in Section 6 of this manual.

GATEWAY REVIEW

CHAPTER 2 THE ALGEBRA OF FUNCTIONS

CLUSTER 1 ADDITION, SUBTRACTION, AND MULTIPLICATION OF POLYNOMIAL FUNCTIONS

Activity 2.1 Spending and Earning Money

Objectives:
1. Identify a polynomial expression.
2. Identify a polynomial function.
3. Add and subtract polynomial expressions.
4. Add and subtract polynomial functions.

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Students are introduced to addition and subtraction of polynomial functions in this activity. You will need to give some guidance using the notation for adding and subtracting functions. In exercise 1 determining the revenue and cost function is difficult for the students. The skill of adding and subtracting expressions will be a review for the students. Broadening this concept to adding and subtracting functions is an easy transition for them.

Activity 2.2 The Dormitory Parking Lot

Objectives:
1. Multiply two binomials using the FOIL Method.
2. Multiply two polynomial functions.
3. Apply the property of exponents to multiply powers having the same base.

Products of functions are explored in this activity. Using a geometric representation, polynomials are multiplied. Students will not have seen this before, but it is not a difficult concept for them. It is a nice way of organizing the information especially when multiplying two trinomials or higher order polynomials. Students are familiar with multiplying binomials using the distributive property (FOIL). The property of exponents, $x^m \cdot x^n = x^{m+n}$, is developed because of the necessity of using multiplication with higher order polynomials. Students will be able to complete this activity with little instruction.

Activity 2.3 Stargazing

Objectives:
1. Convert scientific notation to decimal notation.
2. Convert decimal notation to scientific notation.
3. Apply the property of exponents to divide powers having the same base.
4. Apply the definition of exponents $a^0 = 1,$ where $a \neq 0.$
5. Apply the definition of exponents, $a^{-n} = \frac{1}{a^n},$ where $a \neq 0,$ and n is any real number.

This activity gives us a wonderful opportunity to review scientific notation in the context of some actual data and in doing so the students will discover three more properties of exponents. Students will see the necessity for Objectives 3, 4, and 5 as they progress through the activity. You may need to point out the properties and practice examples of each since the operation will seem more like common sense to them within the context of the activity. The zero property is always a struggle for some students.

Activity 2.4 The Cube of a Square

Objectives:
1. Apply the property of exponents to simplify an expression involving a power to a power.
2. Apply the property of exponents to expand the power of a product.
3. Determine the *n*th root of a real number.
4. Write a radical as a power having a rational exponent, and write a base to a rational exponent as a radical.

Students will practice using the power rule of exponents. This is an important skill used in the composition of functions. Students will see the necessity for learning this skill. Roots and fractional exponents and their connection are also explored. More practice using exponents may be found in the Skills Checks Section 6 of this manual.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

There is a skills worksheet in Section 6 of this guide if your students need more practice with operations of polynomials.

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CLUSTER 2 COMPOSITION AND INVERSES OF FUNCTIONS

Activity 2.5 Inflated Balloons

Objectives:
1. Determine the composition of two functions.
2. Explore the relationship between $f(g(x))$ and $g(f(x))$.

Composition of functions is introduced in this activity. Showing students, using a simple example, what composition of functions means as well as the notation for composition, may help students as they approach the contextual problem of this activity. Many times students just do the manipulation not knowing why they are doing it. The inflated balloons activity shows the student that there is a reason for learning the skill of composition. Problem 9 will test whether the student has learned the skill of composition of functions. Some students take more time in understanding this concept and tend to become somewhat frustrated. As you show more examples, each student begins to understand.

Activity 2.6 Finding a Bargain

Objective:
1. Solve problems using the composition of functions.

Exploration of composition of functions continues in this activity. It is a very realistic contextual problem. The students will have difficulty realizing that 25% off is 0.75 of the original price. The exercises at the end of this activity will give the student more practice with composition of functions.

Activity 2.7 Study Time

Objectives:
1. Determine the inverse of a function represented by a table of values.
2. Use the notation f^{-1} to represent an inverse function.
3. Use the property $f(f^{-1}(x)) = f^{-1}(f(x)) = x$ to recognize inverse functions.
4. Determine the domain and range of a function and its inverse.

Interchanging the input and output values to determine the inverse function is the focus of this activity. It is straightforward and very clear. The notation used to represent an inverse function should be explained carefully. Also an example of what is meant by "The composition of a function with its inverse is always the identity function" should be given. Exercises are excellent for reinforcing this section on inverse functions. Students will not have any difficulty doing this activity in groups.

Activity 2.8 Temperature Conversions

Objectives:
1. Determine the equation of the inverse of a function represented by an equation.
2. Describe the relationship between the graphs of inverse functions.
3. Determine the graph of the inverse of a function represented by a graph.
4. Use the graphing calculator to produce graphs of an inverse function.

Students will use the Fahrenheit and Celsius temperature functions to discover that they are inverses. They look at these two functions together numerically, graphically, and symbolically. The emphasis is on the steps used to determine the inverse of a function as well as proving by graphing and by the composition that the two functions are inverses. It may be a good place to summarize and have a whole class discussion on inverse functions and the properties discovered in Activities 2.7 and 2.8.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

You may want to assign some of these exercises as you progress through this cluster.

GATEWAY REVIEW

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CHAPTER 3 EXPONENTIAL AND LOGARITHMIC FUNCTIONS

CLUSTER 1 EXPONENTIAL FUNCTIONS

Activity 3.1 Prince George and Dracula

Objectives:

1. Determine the growth factor of an exponential function.
2. Identify the properties of the graph of an exponential function defined by $y = b^x$, where $b > 1$.
3. Graph an increasing exponential function.

This activity is designed to be an introduction to exponential functions. Students have little trouble completing the table in Problem 1. However they may struggle in arriving at the equation $P(n) = 2^n$. Making connections to show differences between linear and exponential functions is important. When the input is a negative value the concept of negative exponents should be reviewed. You may want to explore the characteristics of the graph of an increasing exponential function with your students. Discussion of the concept of the horizontal asymptote I am sure will be needed.

Activity 3.2 Half-Life of Medicine

Objectives:

1. Determine the decay factor of an exponential function.
2. Graph a decreasing exponential function.
3. Identify the properties of an exponential function defined by $y = b^x$, where $b > 0$ and $b \neq 1$.

The half-life of medicine is a nice situation to explore the decreasing exponential function numerically and to explore the properties of the graph of a decreasing exponential function. At the end of the activity the students should understand that the base of an exponential function is the factor that always separates two outputs whose inputs are consecutive integers. Students should know the difference between a growth and a decay factor numerically, graphically, and symbolically. More practice using negative exponents may be found in Section 6 of this manual.

Activity 3.3 National Debt

Objectives:

1. Determine the growth and decay factor for an exponential function represented by a table of values or an equation.
2. Graph exponential functions defined by $y = ab^x$, where $b > 0$ and $b \neq 1, a \neq 0$.
3. Determine the doubling and halving time.

This activity reinforces the meaning of the constant growth or decay factor introduced in Activities 3.1 and 3.2. Practice in creating the equation of the exponential function and understanding the practical meaning of the growth or decay factor and the vertical intercept is the main focus. Halving time or doubling time is the new concept introduced. One session should be sufficient for this activity.

Activity 3.4 Population Growth

Objectives:

1. Determine annual growth or decay rate of an exponential function represented by a table of values or an equation.
2. Graph an exponential function having equation $y = a(1 + r)^x$.

In this activity students will study the difference between growth (decay) rate and growth (decay) factor. Creating exponential functions given the growth or decay rate rather than numerical data is a new approach for the students. Students will need to practice determining the growth (decay) rate from the equation containing the growth (decay) factor and creating the growth (decay) factor given the growth (decay) rate. Class discussion may be necessary. One session is required for this activity.

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Activity 3.5 Time is Money

Objectives:
1. Apply the compound interest and continuous compounding formulas to a given situation.

In this activity students will explore compound interest as an application of exponential growth. Students will need some guidance in determining the growth factor and the effective yield. This activity also uses continuous compounding interest to introduce the Euler number, *e*. Students have little difficulty in using the formulas introduced in this activity.

Activity 3.6 Continuous Growth and Decay

Objectives:
1. Discover the relationship between the equations of exponential functions defined by $y = ab^t$ and the equations of continuous growth and decay exponential functions defined by $y = ae^{kt}$.
2. Solve problems involving continuous growth and decay models.
3. Graph base *e* exponential functions.

An exponential function becomes the model of the population of the U.S. in this activity. Students then discover how to change an exponential function of the form $y = ab^t$ to a continuous growth exponential function defined by $y = ae^{kt}$. Graphs of increasing and decreasing exponential functions are explored. This is a more complicated activity. It can be skipped with no loss of continuity.

Activity 3.7 Bird Flu

Objectives:
1. Determine the regression equation of an exponential function that best fits the given data.
2. Make predictions using an exponential regression equation.
3. Determine whether a linear or exponential model best fits the data.

In this activity students will explore exponential models. Linear regression was a topic in Chapter 1 and the students should only need a review to apply the process to exponential data. If the students do need a refresher on the STAT PLOT feature of the TI-84 Plus C calculator, they can refer to the appendix.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

There are no surprises here. The exercises are simply more of the same from Activities 3.1 through 3.7.

CLUSTER 2 LOGARITHMIC FUNCTIONS

Activity 3.8 The Diameter of Spheres

Objectives:
1. Define logarithm.
2. Write an exponential statement in logarithmic form.
3. Write a logarithmic statement in exponential form.
4. Determine log and ln values using a calculator.

This activity uses the diameter of several spheres to introduce the concept of a logarithm. Students have a difficult time realizing that a logarithm is an exponent. They need practice in changing back and forth from exponential to logarithmic form. The notation for the common logarithm and the natural logarithm is defined. The graphing calculator is used to determine the value of the common and natural logarithms when the number is not an exact power of the base.

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Activity 3.9 Walking Speed of Pedestrians

Objectives:
1. Determine the inverse of the exponential function.
2. Identify the properties of the graph of a logarithmic function.
3. Graph the natural logarithmic function.

The concept of inverse function permeates this activity. If the students recognize this with little or no prodding they should be congratulated. The major concepts in this activity are the logarithmic function as the inverse of the exponential function, and the related algebraic, graphic, and numerical characteristics. The process of creating the inverse function will be reviewed from Chapter 2. Students will find the domain, range, intercepts, and asymptotes of the common and natural log function. There is a major emphasis on graphing these log functions in this activity.

Activity 3.10 Walking Speed of Pedestrians, continued

Objectives:
1. Compare the average rate of change of increasing logarithmic, linear, and exponential functions.
2. Determine the regression equation of a natural logarithmic function having equation $y = a + b \ln x$ that best fits a set of data.

All through this activity the authors want the students to compare the logarithmic, linear and exponential models. In the logarithmic function, the students should realize that the data appears to be rising but at a slower rate as the input increases which is not a characteristic of either linear or exponential functions. The activity reinforces the characteristics of the log function and uses the graphing calculator to find a logarithmic model of the natural log function. The necessity of using logs to solve for an unknown that is an exponent seems to make sense to students in this activity.

Activity 3.11 The Elastic Ball

Objectives:
1. Apply the log of a product property.
2. Apply the log of a quotient property.
3. Apply the log of a power property.
4. Discover the change of base formula.

In this activity the properties of logarithms (product, quotient, and power) are explored. Using the total rebound distance of an elastic ball, students are introduced to these properties. They use the properties of logarithms (product and quotient) to write the sum or difference of two or more logarithms and then they reverse the operation to write expressions as the logarithm of a single number. Students will use the power property to write a logarithm of a power as the exponent times the logarithm of the base and then learn to reverse the operation. Students have difficulty using the power property with the other two properties because fractional exponents are often necessary and the order of operations must be determined each time. The power property is extended here to develop the change of base formula. Graphing logarithmic functions of bases other than ten is now accomplished on the graphing calculator using this change of base formula.

Activity 3.12 Changing Demographics

Objective:
1. Solve exponential equations both graphically and algebraically.

This activity introduces the solution of exponential equations from graphic and algebraic perspectives. The use of tables can also be used if time permits. Students will use an algebraic model and should practice to understand the algebraic approach to solving exponential equations. Since by this time the students should be very familiar with their calculators, the activity should be completed in one session. If time is a factor, you may want to give the students the model in Problems 3 and 8a.

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WHAT HAVE I LEARNED?

Problem 3 is a review of the course to date. The remaining problems are designed to help the students solidify the concepts of logarithms.

HOW CAN I PRACTICE?

This is a skills-oriented practice designed to review the skills from Activity 3.8 to Activity 3.13.

GATEWAY REVIEW

CHAPTER 4 QUADRATIC AND HIGHER-ORDER POLYNOMIAL FUNCTIONS

CLUSTER 1 INTRODUCTION TO QUADRATIC FUNCTIONS

Activity 4.1 Baseball and the Willis Tower

Objectives:

1. Identify functions of the form $f(x) = ax^2 + bx + c$ as quadratic functions.
2. Explore the role of c as it relates to the graph of $f(x) = ax^2 + bx + c$.
3. Explore the role of a as it relates to the graph of $f(x) = ax^2 + bx + c$.
4. Explore the role of b as it relates to the graph of $f(x) = ax^2 + bx + c$.

   Note: $a \neq 0$ in Objectives 1 - 4.

This activity is an introduction to quadratic functions and the relationship between the type of equations that define such functions and their graphs. Students are asked to place themselves in a setting that they should be familiar with—the motion of a free-falling object. Students should be encouraged to complete the table at the start of the activity using the TABLE feature of their calculator. After the student discovers that the relationship between the height of the object and time is not linear (rate of change not constant), the general form of the quadratic function is defined. This should provide some good group work as the student begins to discover some of the important features of the graphs of parabolas. Students will begin to identify the effect the values a, b, and c in the equation $y = ax^2 + bx + c$ have on the graph of a quadratic function. Overall, this is a good activity to be done in groups with guidance from the instructor. Although a summary is provided at the end of the activity, having students verbalize what they have learned should reinforce the concepts.

Activity 4.2 The Shot Put

Objectives:

1. Determine the vertex, or turning point, of a parabola.
2. Identify the vertex as a maximum or minimum.
3. Determine the axis of symmetry of a parabola.
4. Identify the domain and range.
5. Determine the y-intercept of a parabola.
6. Determine the x-intercept(s) of a parabola using technology.
7. Interpret the practical meaning of the vertex and intercepts in a given problem.

A quadratic function is used to model the path of a shot put. This activity is designed to introduce in a contextual setting all the important features and terminology of the graph of a quadratic function. The vertex is approximated using the graphing calculator as well as determined exactly using a formula. The x-intercept(s) is determined using the graphing calculator. Students may have trouble with the horizontal distance (x-interval) over which the function is increasing or decreasing. It is important that the student

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make the connection to real life when discussing the vertex and intercepts. This activity, including the exercises, may take two class periods to complete.

Activity 4.3 Per Capita Personal Income

Objectives:
1. Solve quadratic equations numerically.
2. Solve quadratic equations graphically.
3. Solve quadratic inequalities graphically.

In this activity you will use the graphing calculator to solve quadratic equations numerically (table) and graphically. Students, when graphing, should understand the connection between using the intersection method and finding the zeros of the function. You will have to carefully guide the class through the two graphing methods. These graphing approaches to solve equations are used throughout the text. A nice extension to solving quadratics by graphing is to solve a quadratic inequality graphically. Solving equations graphically helps to give meaning to the algebraic approach that follows in the next two activities.

Activity 4.4 Sir Isaac Newton

Objectives:
1. Use the zero-product principle to solve equations.
2. Factor expressions by removing the greatest common factor.
3. Factor trinomials using trial and error.
4. Solve quadratic equations by factoring.

Quadratic equations are solved using an algebraic approach. First the skill of factoring out the greatest common factor and factoring trinomials by trial and error is developed. Students may need extra help in reviewing factoring. The appendix and Skills Checks Section 6 in this Instructor's Resource Manual contain extra problems for practice. Using this factoring skill to solve quadratic equations gives the students a reason to learn to factor. Working in groups may not be the best way to handle this activity. Guidance from the instructor and some structure to the class will help accomplish more with the skills that need to be reviewed and/or developed. Assigning some exercises from the appendix as well as exercises following the activity should provide ample practice.

Activity 4.5 Price of Gold

Objective:
1. Solve quadratic equations by the quadratic formula.

The quadratic formula is given in this activity as a method to solve quadratic equations. It is used most often when a quadratic equation will not factor. Having students check the solution graphically helps them make the connection that they really are finding the horizontal intercepts from the graph. The details of the development of the quadratic formula as well as completing the square are presented in the appendix.

Activity 4.6 Heat Index

Objectives:
1. Determine quadratic regression models using a graphing calculator.
2. Solve problems using quadratic regression models.

The focus of this activity is to determine the regression equation of a quadratic function that best fits a set of data. A review of the regression feature of the graphing calculator and STAT PLOT will more than likely be needed. At this point in the course students will have an understanding of curve fitting and modeling and should not have a problem with the process. Overall, this activity reinforces how mathematical models are developed from data and some of the uses and abuses of such models. The model will then be used to answer questions and make predictions from the data.

Activity 4.7 Complex Numbers

Objectives:
1. Identify the imaginary unit $i = \sqrt{-1}$.

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2. Identify complex numbers, $a + bi$.
3. Determine the value of the discriminant $b^2 - 4ac$ used in the quadratic formula.
4. Solve quadratic equations in the complex number system.
5. Determine the types of solutions to quadratic equations.

This activity works nicely using the graphing calculator to show the given function with no x-intercepts. Students then solve the quadratic equation using the quadratic formula and discover the negative value under the radical. At this point, an explanation of imaginary and complex numbers can be given. Operations using complex numbers should be introduced. The number and types of solutions to a quadratic equation using the discriminant value is discussed. This provides a good opportunity to reinforce the patterns discussed by looking for the x-intercepts on corresponding graphs. This activity can be completed in groups or by having a whole class discussion. More practice with the operations of complex numbers may be found in the Skills Checks Section 6 of this Instructor's Resource Manual.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

More practice in discovering the characteristics of the graph of the quadratic function is included in these exercises. There is a skills check worksheet on quadratic inequalities in Section 6 of this manual.

CLUSTER 2 CURVE FITTING AND HIGHER-ORDER POLYNOMIAL FUNCTIONS

Activity 4.8 The Power of Power Functions

Objectives:

1. Identify a direct variation function.
2. Determine the constant of variation.
3. Identify the properties of graphs of power functions defined by $y = kx^n$, where n is a positive integer, $k \neq 0$.

Power functions are introduced using a scenario involving a free-falling object. The input-output relationship modeled by $y = kx^n$ is interpreted as a direct variation relationship. (Note that inverse variations are discussed in Chapter 5.) Students will need careful guidance during the first part of the activity (Problems 1–5), especially with the terminology and the determination and interpretation of the constant of variation. After the family of functions called power functions is defined, the subsequent Problems (6–8) can be accomplished in groups. A quick review of transformations may be necessary. The effect that the value of the exponent n (in $y = kx^n$) has on the graph should be summarized. Also, have students compare the rate of increase/decrease of the graphs of power functions.

Activity 4.9 Volume of a Storage Tank

Objectives:

1. Identify equations that define polynomial functions.
2. Determine the degree of a polynomial function.
3. Determine the intercepts of the graph of a polynomial function.
4. Identify the properties of the graphs of polynomial functions.

This activity is designed to introduce polynomial functions by determining the volume of a partially cylindrical storage tank. It gives the student a practical situation in which such a function evolves. The general form of a polynomial function including the degree and the name of the function is discussed. The focus of the activity is using the graphing calculator to sketch the graph of various higher order polynomial functions. An extensive treatment of the topic is left for pre-calculus. However, identifying patterns such as the number of turning points, approximating graphically local extreme points and x-intercepts can be done. Solving higher-order polynomial equations using factoring helps the student review the topic of factoring.

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Activity 4.10 Federal Prison Population

Objective: 1. Determine the regression equation of a polynomial function that best fits the data.

Curve fitting is a recurring theme in this text. Students should be comfortable with the regression feature of their graphing calculator and with STAT PLOT. The class discussion can focus more on how to determine the curve of best fit rather than which keys to push to acquire the regression equation. The level of treatment on how to answer the questions of which curve seems to best fit the data depends on the level of ability of the class. Mention of the coefficient of determination might be in order at this time. Discrete versus continuous functions is again emphasized in this activity.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

GATEWAY REVIEW

CHAPTER 5 RATIONAL AND RADICAL FUNCTIONS

CLUSTER 1 RATIONAL FUNCTIONS

Activity 5.1 Speed Limits

Objectives:
1. Determine the domain and range of functions defined by $y = \frac{k}{x}$, where k is a nonzero real number.
2. Determine the vertical and horizontal asymptotes of the graphs of $y = \frac{k}{x}$.
3. Sketch graphs of functions of the form $y = \frac{k}{x}$.
4. Determine the properties of graphs having equation $y = \frac{k}{x}$.

Students, working in their groups, will find this activity very manageable. Some groups may need prompting on distance-rate-time calculations, and a brief discussion of unit analysis may be in order. There may be some difficulty in graphing because of the asymptotic behavior, which should lead into class discussion on the meaning of asymptotes. Further discussion of domain will probably be very helpful.

Activity 5.2 Loudness of a Sound

Objectives:
1. Graph functions defined by an equation of the form $y = \frac{k}{x^n}$, where n is a positive integer and k is a nonzero real number, $x \neq 0$.
2. Describe the properties of graphs having equation $y = \frac{k}{x^n}$, $x \neq 0$.
3. Determine the constant of proportionality (also called the constant of variation).

This is a natural continuation of the previous activity, where the same concepts can be reemphasized. Again, producing graphs by hand will require careful scaling of the axes, so the instructor should carefully monitor student's progress, and perhaps lead a discussion on how to interpret the graphs using the graphing calculator. Inverse variation is explored in relationship to inverse variation functions. Students easily connect this with their past experience with variation.

Activity 5.3 Percent Markup

Objectives:
1. Determine the domains of rational functions defined by an equation of the form $y = \frac{k}{g(x)}$, where k is a nonzero constant and $g(x)$ is a first-degree polynomial.
2. Identify the vertical and horizontal asymptotes of $y = \frac{k}{g(x)}$.
3. Sketch graphs of rational functions defined by $y = \frac{k}{g(x)}$.

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Be careful when helping students understand the markup calculation. This is the way retailers perform the calculation. Since generalized rational functions are defined here, some review of division by zero will be appropriate. There should be immediate synthesis at the end of this activity as to the relationship between the domain and vertical asymptotes.

Activity 5.4 Blood-Alcohol Levels

Objectives:
1. Solve an equation involving a rational expression using an algebraic approach.
2. Solve an equation involving a rational expression using a graphing approach.
3. Determine horizontal asymptotes of the graph of $y = \frac{f(x)}{g(x)}$, where $f(x)$ and $g(x)$ are first-degree polynomials.

Students will typically make the blood-alcohol model more difficult than it need be, because of the number of quantities involved in the set-up. Make sure individuals in each group have their own function, based on the independent variable, w. The practical domain in this problem is rather critical. You may want a whole class discussion once each group has completed Problem 3. This activity also introduces solving equations involving rational expressions. Some discussion may be necessary to help students recall the algebraic process. Special attention may be required to make sure students are also solving by using a graphical approach. When exploring horizontal asymptotes in Problem 7, make sure students realize the potential of their calculator's table feature to examine very large or small numbers in the domain.

Activity 5.5 Traffic Flow

Objectives:
1. Determine the least common denominator (LCD) of two or more rational expressions.
2. Solve an equation involving rational expressions using an algebraic approach.
3. Solve a formula for a specific variable.

A model for working together is developed using the traffic flow in a new auditorium. The result is a rational equation that must be solved both algebraically and graphically. Students will see the reason for finding the least common denominator (LCD). Showing the graphical approach will help students make the connection between the algebraic solution and the x-value of the intersection of the graphs. Solving a formula for a specified letter is introduced here. You may want to stress the efficiency of solving for a specified letter when many calculations of the formula are necessary.

Activity 5.6 Electrical Circuits

Objectives:
1. Multiply and divide rational expressions.
2. Add and subtract rational expressions.
3. Simplify complex fractions.

This activity is a continuation of Activity 5.5. The main focus is on simplifying complex fractions, although in doing that, skills are reviewed on adding, subtracting, multiplying and dividing rational expressions. Again, when solving an equation containing a complex fraction, it is important to make the graphical connection.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

Practice simplifying rational expressions and solving rational equations may be found in Section 6 of this manual as well as a worksheet on solving rational inequalities algebraically and graphically.

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CLUSTER 2 RADICAL FUNCTIONS

Activity 5.7 Sky Diving

Objectives:

1. Determine the domain of a radical function defined by $y = \sqrt{g(x)}$, where $g(x)$ is a polynomial.
2. Graph functions having equation $y = \sqrt{g(x)}$ and $y = -\sqrt{g(x)}$.
3. Identify the properties of the graph of $y = \sqrt{g(x)}$ and $y = -\sqrt{g(x)}$.

This activity introduces the student to radical functions by creating an inverse of a power function. As students diligently plot data points, encourage them to use the table feature of their calculator to generate the data, and to use the graphing calculator to see the graph they should be sketching. Also monitor and review the inverse function concept as they progress through the contextual part of this activity. The properties of radical functions and their graphs are explored. Major emphasis should be on determining the domain of the square root function and sketching the graph after determining the properties.

Activity 5.8 Falling Objects

Objective:

1. Solve an equation involving a radical expression using a graphical and algebraic approach.

The motivation for this situation is to solve equations containing a radical. Example 3 may be confusing to some students, so be prepared to intervene and ask pointed questions that help them through the process. You may have to model how to solve an equation containing a radical expression both algebraically and graphically. The first exposure to extraneous roots is in Problem 5. More practice in solving radical equations may be found in Section 6 of this manual.

Activity 5.9 Propane Tank

Objectives:

1. Determine the domain of a function defined by an equation of the form $y = \sqrt[n]{g(x)}$, where n is a positive integer and $g(x)$ is a polynomial.
2. Graph $y = \sqrt[n]{g(x)}$.
3. Identify the properties of graphs of $y = \sqrt[n]{g(x)}$.
4. Solve radical equations that contain radical expressions with an index other than 2.

In this activity properties of cube root functions are explored. Students will be able to extend their knowledge of fractional exponents and inverse functions to this activity. Making students aware of the connection between the algebraic solution and the graph is important. Solving equations containing *nth* root expressions should not be difficult.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

GATEWAY REVIEW

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CHAPTER 6 INTRODUCTION TO THE TRIGONOMETRIC FUNCTIONS

CLUSTER 1 INTRODUCING THE SINE, COSINE, AND TANGENT FUNCTIONS

Activity 6.1 The Leaning Tower of Pisa

Objectives:
1. Identify the sides and corresponding angles of a right triangle.
2. Determine the length of the sides of similar right triangles using proportions.
3. Determine the sine, cosine, and tangent of an angle within a right triangle.
4. Determine the sine, cosine, and tangent of an acute angle by use of the graphing calculator.

This activity begins with the vocabulary of the right triangle. The ratios of the sides of similar triangles versus triangles whose sides are not similar lead to the development of the sine, cosine, and tangent functions. The input is the angle and the output is the ratio should be emphasized. When an angle and a side are given, it is difficult for the student at first to determine which function should be used. Trigonometric values of special angles should be emphasized. The practice exercises help to reinforce the definitions of the three functions and doing all parts of this activity and the exercises is recommended.

Activity 6.2 A Gasoline Problem

Objectives:
1. Identify complementary angles.
2. Demonstrate that the sine of one of the complementary angles equals the cosine of the other.

Students will be able to do this activity in their groups with some guidance. Complementary angles and cofunctions are defined. The gasoline problem leads the student through the development of the concept that cofunctions of complementary angles are equal.

Activity 6.3 The Sidewalks of New York

Objectives:
1. Determine the inverse tangent of a number.
2. Determine the inverse sine and cosine of a number using the graphing calculator.
3. Identify the domain and range of the inverse sine, cosine, and tangent functions.

Determining the input given the output leads the student once again to inverse functions. They see the interchange of the input and output to create the inverse functions. The notation for inverse trig functions and the calculator keys used to determine the inverse are defined. The need to determine the angle in a right triangle given the ratio is emphasized through contextual problems.

Activity 6.4 Solving a Murder

Objective:
1. Determine the measure of all sides and all angles of a right triangle.

This activity brings together all that was learned in Activities 6.1–6.3. The topic is solving right triangles or finding all of the angles and the length of each side of the right triangle. Students should be able to do this activity with little guidance.

Activity 6.5 How Stable is That Tower?

Objectives:
1. Solve problems using right triangle trigonometry.
2. Solve optimization problems using right triangle trigonometry with a graphing approach.

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At this point the student should have all of the skills needed to do some problem solving. There are three situations presented in this activity. The student may have to draw a diagram of the situation, determine which trig function to use, set up the appropriate equation and solve for the unknown. Students will need guidance in this activity. Setting up the equations will be difficult for them.

WHAT HAVE I LEARNED?

HOW CAN I PRACTICE?

CLUSTER 2 WHY ARE THE TRIGONOMETRIC FUNCTIONS CALLED CIRCULAR FUNCTIONS?

Activity 6.6 Learn Trig or Crash!

Objectives:
1. Determine the coordinates of points on a unit circle using sine and cosine functions.
2. Sketch the graph of $y = \sin x$ and $y = \cos x$.
3. Identify the properties of the graphs of the sine and cosine functions.

In this activity students will learn the connection between right triangle trigonometry and the unit circle. Students may need some guidance. The important concept of periodicity is introduced. The graphs of the sine and cosine function are introduced for the first time. The domain and range of the sine and cosine function are determined.

Activity 6.7 It Won't Hertz

Objectives:
1. Convert between degree and radian measure.
2. Identify the period and frequency of a function defined by $y = a\sin(bx)$ or $y = a\cos(bx)$ using the graph.

Radian angle measure is introduced for the first time and students will need to practice changing from degree to radian measure and vice versa. Vocabulary, such as cycle, period, and frequency are defined. Graphing functions using radian mode helps students see the cyclical nature of the functions.

Activity 6.8 Get in Shape

Objectives:
1. Determine the amplitude of the graph of $y = a\sin(bx)$ or $y = a\cos(bx)$.
2. Determine the period of the graph of $y = a\sin(bx)$ and $y = a\cos(bx)$ using a formula.

The focus of this activity is determining the amplitude and the period of the function. Using tables and or graphs to determine your position at a particular point (when the amplitude is other than one) helps to reinforce the concept of amplitude. Students seem to grasp this concept rather easily. Understanding the concept of frequency and period of the function will require more attention.

Activity 6.9 The Carousel

Objective:
1. Determine the displacement of $y = a\sin(bx + c)$ and $y = a\cos(bx + c)$ using a formula.

The displacement or phase shift of the graph is presented in this activity. Students learn how to determine the phase shift from looking at the equation and from the graph. At this point the amplitude, period and displacement should come together and students should be able to identify each from the equation, from a table, and from the graph.

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Activity 6.10 Texas Temperatures

Objectives: 1. Determine the equation of a sine function that best fits the given data.
2. Make predictions using a sine regression equation.

The students will see how the sine function can be used to model periodic wavelike behavior. Students will use their graphing calculator to find a sine regression model. This process should be easy for them.

WHAT HAVE I LEARNED?

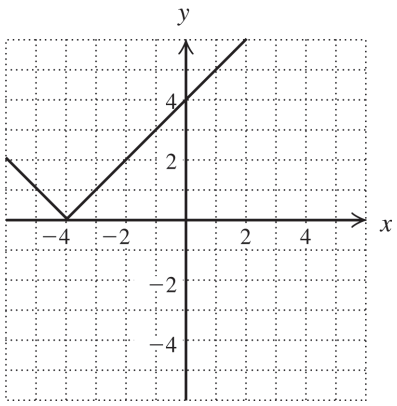
HOW CAN I PRACTICE?

GATEWAY REVIEW

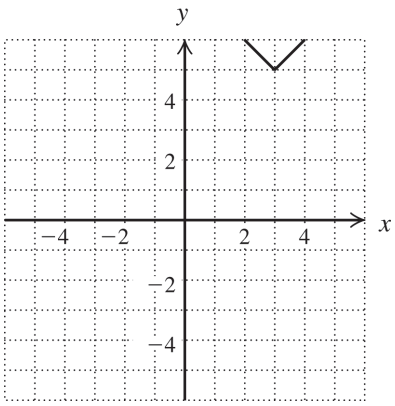
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25.



27.



Concept Connections

29. A piecewise function is a function that is defined different for certain "pieces" of the function. The output value is calculated differently depending on the input value.

Chapter 2 THE ALGEBRA OF FUNCTIONS

Activity 2.1

Key Terms

1. trinomial
3. binomial

Practice Exercises

5. no
7. yes, monomial
9. yes, trinomial
11.

x	-1	1	3	5	7	9
$f(x)+g(x)$	-8	-3	4	9	14	19
$f(x)-g(x)$	-4	-3	-4	-3	-2	-1

13. x^2-x+9
15. $-x^2+5x-3$
17. $-8x^2+18x-5$
19. $-34x-11$
21. $2x^2-x$
23. $4x^2-4x+7$
25. $6-8=-2$
27. $3-1=2$

Concept Connections

29. Paul is right. $\sqrt{3}+x$ is a polynomial, but $\sqrt{3+x}$ is not.

Activity 2.2

Practice Exercises

1. 5^{11}
3. u^3v^6
5. $24x^{13}$
7. x^{4n}

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9. $x^2+10x+16$
11. $x^2+3x-40$
13. x^2-16
15. $4x^2-19x+12$
17. $x^3-x^2-6x+18$
19. x^3-64
21. $x^2-10x+25$
23. $25x^2-16$
25. $x^2-50x+625$
27. $x^2-22x+121$

Concept Connections

29. Difference of squares: Exercises 13, 23, 24, 28.
Square of a binomial: Exercises 21, 22, 25, 26, 27.

Activity 2.3

Key Terms

1. exponential notation

Practice Exercises

3. 9.6×10^{11}
5. 7.7×10^{14}
7. 1.04×10^{7}
9. 0.000000421
11. 900,000
13. 0.00072
15. 4.0×10^{14}
17. u^3
19. 1
21. $\dfrac{7}{x^4}$
23. $3w^4$
25. $\dfrac{6y^7z}{x^3}$
27. $\dfrac{6c^5}{d^5}$

Concept Connections

29. $4x^0$ is equivalent to 4. $(4x)^0$ is equivalent to 1.

Activity 2.4

Key Terms

1. radicand
3. principal square root

Practice Exercises

5. x^{32}
7. $-125x^{12}$
9. $\dfrac{36}{w^{14}}$
11. $-a^{40}$
13. 8
15. –8
17. $\dfrac{1}{25}$
19. $x^{1/15}$

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21. $a^{1/2}$
23. $(a-b)^{1/3}$
25. 0
27. –2

Concept Connections

29. Answers will vary. Remind Jeff what $(x^3)^4$ means: $(x^3)^4 = x^3 \cdot x^3 \cdot x^3 \cdot x^3 = x^{3+3+3+3} = x^{12}$. For y^5y^3, substituting a value for y (other than 0 or 1), will help Jeff check his answer: $y^5y^3 = y^{5+3} = y^8$, let $y = 2$. $2^52^3 = 32 \cdot 8 = 256,$ and $2^8 = 256.$

Activity 2.5

Practice Exercises

1. 8
3. $f(\text{BOB}) = 3(\text{BOB}) + 2$
5. $f(g(x)) = 3(g(x)) + 2$
7. $g(a) = 2a^2 - 3a + 1$
9. $g(h(x)) = 2(h(x))^2 - 3(h(x)) + 1$
11. $f(g(2)) = 17$
13. $g(f(2)) = 25$
15. $f(g(x)) = 10x - 27$
17. $g(f(x)) = 10x - 9$
19. no
21. $f(g(-1)) = 11$
23. $g(f(-1)) = 71$
25. $f(g(x)) = x$
27. $g(f(x)) = x$

Concept Connections

29. Answers may vary. Using the pairs of functions preceding Exercise #10, or Exercise #15, or Exercise #20, we can see that in general $f(g(x)) \neq g(f(x))$.

Activity 2.6

Practice Exercises

1. $f(x) = 0.06x$
3. The sales tax for a \$20.99 dinner is \$1.26.
5. $g(20.99) = \$22.25$
7. $h(x) = 0.18(1.06x) = 0.1908x$
9. The customary tip for a \$20.99 dinner is \$4.00.
11. $k(20.99) = \$26.25$
13. $f(x) = \dfrac{x}{15}$
15. 30 runs are needed to deliver 450 floral arrangements.
17. $g(450) = 10$
19. $P(x) = 3.25x$
21. The florist will pay the drivers a total of \$1462.50 for all of the deliveries.
23. $d(450) = 1350$
25. $B(x) = 0.51(3x) = 1.53x$
27. The total mileage expense for the delivery of 450 floral arrangements is \$688.50.

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Concept Connections

29. The first deal results in a 49% discount. The second deal results in a 44% discount. The first deal is better.

Activity 2.7

Practice Exercises

1. $k^{-1} = \{(15, 0), (12, 1), (-5, 2), (7, 3), (6, 9)\}$
3. $R = \{15, 12, -5, 7, 6\}$
5. $R = \{0, 1, 2, 3, 9\}$
7. $k^{-1}(12) = 1$
9. $k(3) = 7$
11. $k^{-1}(k(3)) = 3$
13. $k^{-1}(k(x)) = x$
15. The cost to rent a car for 3 hours is \$40.
17.

Cost	30	35	40	45	50	55	60
Hours rented	1	2	3	4	5	6	7

19. $H(55) = 6$
21. $D = \{30, 35, 40, 45, 50, 55, 60\}$
$R = \{1, 2, 3, 4, 5, 6, 7\}$
23. $C(7) = 60$
25. $H(C(7)) = H(60) = 7$
27. $H(C(x)) = x$

Concept Connections

29. $f^{-1}(x)$ represents the inverse of the function $f(x)$. $\dfrac{1}{f(x)}$ represents the reciprocal of the function $f(x)$.

Activity 2.8

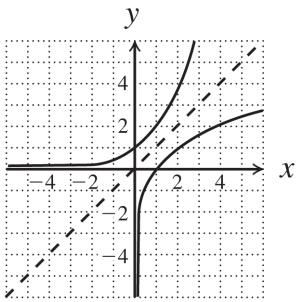
Practice Exercises

1. $f^{-1}(x) = \dfrac{x+7}{3}$
3. $f^{-1}(a) = \dfrac{5-a}{6}$
5. $h^{-1}(x) = 2x + 1$
7. $g^{-1}(x) = 4 - 3x$
9. $w^{-1}(x) = x - 5$
11. $f^{-1}(x) = \dfrac{x-9}{9}$
13. $h^{-1}(x) = 2x - 2$
15. $g^{-1}(x) = 0.4x + 2$
17. yes
19. no
21. no
23. no
25. $g(5) = 3$

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27.



Concept Connections

29. The graphs of inverse functions are reflections about the line $y = x$.

Chapter 3 EXPONENTIAL AND LOGARITHMIC FUNCTIONS

Activity 3.1

Practice Exercises

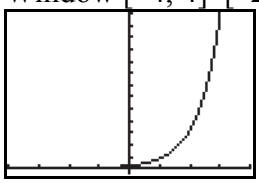
1.

x	-3	-2	-1	0	1	2	3
$f(x)$	-12	-8	-4	0	4	8	12

3.

x	-3	-2	-1	0	1	2	3
$f(x)$	81	16	1	0	1	16	81

5. Window [–4, 4] [–2, 65]



7.

x	-3	-2	-1	0	1	2	3
$f(x)$	54	24	6	0	6	24	54

9.

x	-3	-2	-1	0	1	2	3
$f(x)$	0.005	0.03	0.17	1	6	36	216

11. 6

13. $\frac{9}{5}$

15. Since $0.5 < 1$, it is not a growth factor.

17. This is not an exponential function; there is no growth factor.

19.

x	-3	-2	-1	0	1	2	3
$f(x)$	0.002	0.016	0.125	1	8	64	512

21. $y > 0$

23. 8

25. None

27. The x-axis ($y = 0$)

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