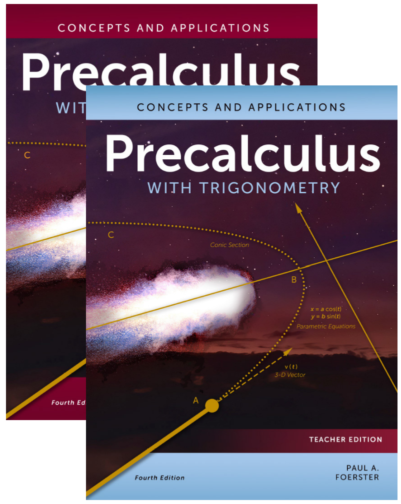
Precalculus

WITH TRIGONOMETRY



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- CAS Problems
- Explorations
- Interactive Problems
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- PowerPoints
- Blackline Masters
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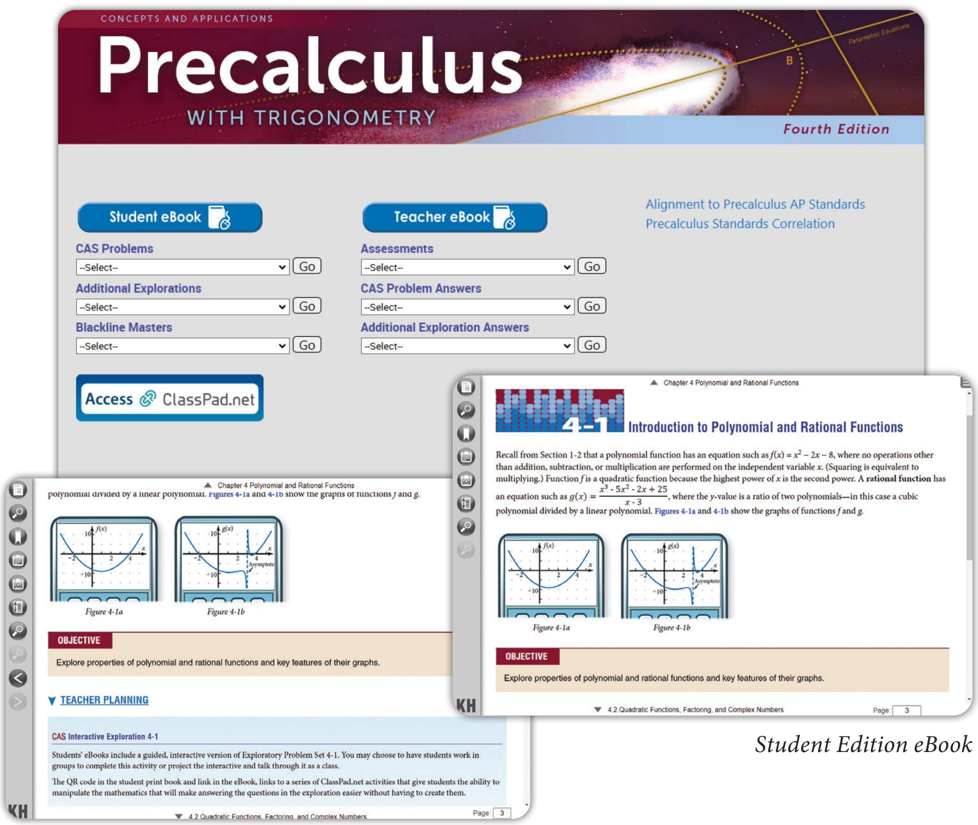


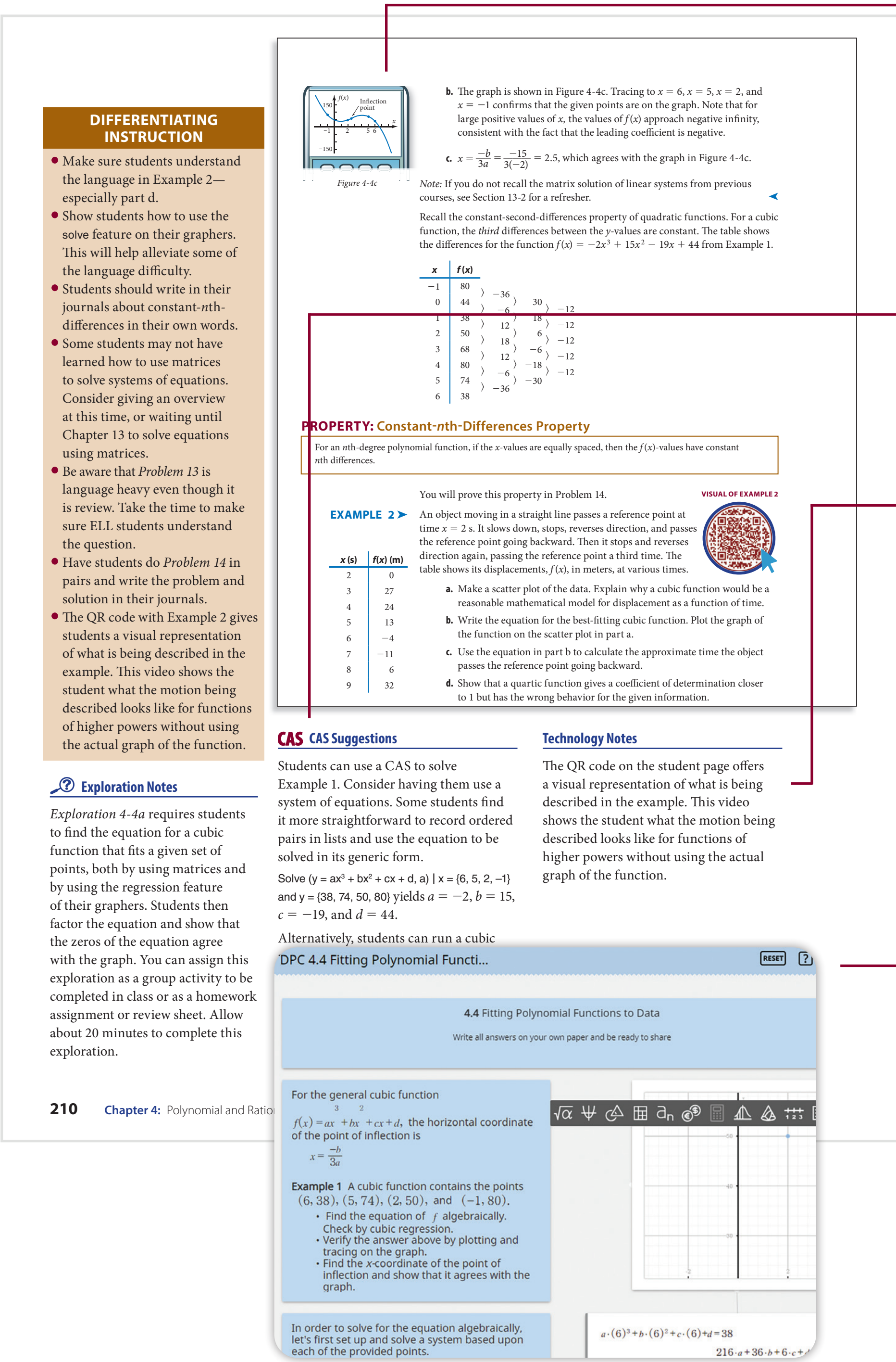
Student Edition eBook

Teacher Edition eBook

TECHNOLOGY

Ignite mathematical reasoning through the use of technology.

Precalculus fully integrates technology to help you illustrate difficult concepts and to give students the opportunity to explore ideas, draw mathematical conclusions, and test hypotheses. With this curriculum you can bring everyday relevance to abstract concepts, spark mathematical thinking, and prepare students for AP® Calculus.



DIFFERENTIATING INSTRUCTION

- Make sure students understand the language in Example 2—especially part d.
- Show students how to use the solve feature on their graphers. This will help alleviate some of the language difficulty.
- Students should write in their journals about constant-*n*th-differences in their own words.
- Some students may not have learned how to use matrices to solve systems of equations. Consider giving an overview at this time, or waiting until Chapter 13 to solve equations using matrices.
- Be aware that *Problem 13* is language heavy even though it is review. Take the time to make sure ELL students understand the question.
- Have students do *Problem 14* in pairs and write the problem and solution in their journals.
- The QR code with Example 2 gives students a visual representation of what is being described in the example. This video shows the student what the motion being described looks like for functions of higher powers without using the actual graph of the function.

Exploration Notes

Exploration 4-4a requires students to find the equation for a cubic function that fits a given set of points, both by using matrices and by using the regression feature of their graphers. Students then factor the equation and show that the zeros of the equation agree with the graph. You can assign this exploration as a group activity to be completed in class or as a homework assignment or review sheet. Allow about 20 minutes to complete this exploration.

Figure 4-4c

b. The graph is shown in Figure 4-4c. Tracing to $x = 6$, $x = 5$, $x = 2$, and $x = -1$ confirms that the given points are on the graph. Note that for large positive values of x, the values of $f(x)$ approach negative infinity, consistent with the fact that the leading coefficient is negative.

c. $x = \frac{-b}{3a} = \frac{-15}{3(-2)} = 2.5$, which agrees with the graph in Figure 4-4c.

Note: If you do not recall the matrix solution of linear systems from previous courses, see Section 13-2 for a refresher.

Recall the constant-second-differences property of quadratic functions. For a cubic function, the *third* differences between the y-values are constant. The table shows the differences for the function $f(x) = -2x^3 + 15x^2 - 19x + 44$ from Example 1.

x	f(x)			
−1	80	−36	30	−12
0	44	−6	18	−12
1	38	12	6	−12
2	50	18	−6	−12
3	68	12	−18	−12
4	80	−6	−30	
5	74	−36		
6	38			

PROPERTY: Constant-*n*th-Differences Property

For an nth-degree polynomial function, if the x-values are equally spaced, then the $f(x)$-values have constant nth differences.

You will prove this property in Problem 14.

VISUAL OF EXAMPLE 2

EXAMPLE 2 An object moving in a straight line passes a reference point at time $x = 2$ s. It slows down, stops, reverses direction, and passes the reference point going backward. Then it stops and reverses direction again, passing the reference point a third time. The table shows its displacements, $f(x)$, in meters, at various times.

x (s)	f(x) (m)
2	0
3	27
4	24
5	13
6	−4
7	−11
8	6
9	32

a. Make a scatter plot of the data. Explain why a cubic function would be a reasonable mathematical model for displacement as a function of time.

b. Write the equation for the best-fitting cubic function. Plot the graph of the function on the scatter plot in part a.

c. Use the equation in part b to calculate the approximate time the object passes the reference point going backward.

d. Show that a quartic function gives a coefficient of determination closer to 1 but has the wrong behavior for the given information.

CAS Suggestions

Students can use a CAS to solve Example 1. Consider having them use a system of equations. Some students find it more straightforward to record ordered pairs in lists and use the equation to be solved in its generic form.

Solve (y = ax³ + bx² + cx + d, a) | x = {6, 5, 2, −1} and y = {38, 74, 50, 80} yields $a = -2$, $b = 15$, $c = -19$, and $d = 44$.

Alternatively, students can run a cubic

Technology Notes

The QR code on the student page offers a visual representation of what is being described in the example. This video shows the student what the motion being described looks like for functions of higher powers without using the actual graph of the function.

210 Chapter 4: Polynomial and Ratio

DPC 4.4 Fitting Polynomial Functi...

4.4 Fitting Polynomial Functions to Data

Write all answers on your own paper and be ready to share

For the general cubic function $f(x) = ax^3 + bx^2 + cx + d$, the horizontal coordinate of the point of inflection is $x = \frac{-b}{3a}$

Example 1 A cubic function contains the points (6, 38), (5, 74), (2, 50), and (−1, 80).
- Find the equation of f algebraically. Check by cubic regression.
- Verify the answer above by plotting and tracing on the graph.
- Find the x-coordinate of the point of inflection and show that it agrees with the graph.

In order to solve for the equation algebraically, let's first set up and solve a system based upon each of the provided points.

$a \cdot (6)^3 + b \cdot (6)^2 + c \cdot (6) + d = 38$

- Students use **graphing calculators** every day to visually explore functions and other topics, investigate real-world applications, and prepare for AP Calculus.
- Optional **CAS Suggestions** in the Teacher's Edition help you integrate the use of CAS technology.
- **Technology Notes** suggest ways you can enrich your course with the use of embedded videos or the CAS Activities. They also provide guidance for using calculator programs.

CAS Problems enhance the problem set for students using a CAS.

- **Interactive Explorations** offer students a dynamic pathway to grasp complex mathematical concepts in the Student Edition.