

Precalculus for Team-Based Inquiry Learning

2024 Development Edition

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¹teambasedinquirylearning.github.io/precalculus/

²github.com/TeamBasedInquiryLearning/precalculus/blob/main/LICENSE.md

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Chapter 1

Polynomial and Rational Functions (PR)

Objectives

BIG IDEA for the chapter goes here, in outcomes/main.ptx

By the end of this chapter, you should be able to...

1. Graph quadratic functions and identify their axis of symmetry, and maximum or minimum point.
2. Use quadratic models to solve an application problem and establish conclusions.
3. Rewrite a rational function as a polynomial plus a proper rational function.
4. Determine the zeros of a real polynomial function, write a polynomial function given information about its zeros and their multiplicities, and apply the Factor Theorem and the Fundamental Theorem of Algebra.
5. Find the intercepts, estimated locations of maxima and minima, and end behavior of a polynomial function, and use this information to sketch the graph.
6. Find the domain and range, vertical and horizontal asymptotes, and intercepts of a rational function and use this information to sketch the graph.

Readiness Assurance. Before beginning this chapter, you should be able to...

a Readiness Outcome 1

- Review:
- Practice:

b Readiness Outcome 2

- Review:
- Practice:

1.1 Graphing Quadratic Functions (PR1)

Objectives

- Graph quadratic functions and identify their axis of symmetry, and maximum or minimum point.

1.1.1 Activities

Activities go here! Don't forget to put text in `<p>` tags or it won't show up.

Activity 1.1.1 Activities may start with an `<introduction>`.

(a) Then we can ask students to do some `<task>`s.

(b) Here's a second `<task>`.

1.1.2 Videos

It would be great to include videos down here, like in the Calculus book!

1.2 Quadratic Models and Meanings (PR2)

Objectives

- Use quadratic models to solve an application problem and establish conclusions.

1.2.1 Activities

Activities go here! Don't forget to put text in `<p>` tags or it won't show up.

Activity 1.2.1 A water balloon is tossed vertically from a fifth story window. It's height $h(t)$, in meters, at a time t , in seconds, is modeled by the function

$$h(t) = -5t^2 + 20t + 25$$

(a) Complete the following table.

Table 1.2.2

t	$h(t)$
0	
1	
2	
3	
4	
5	

- (b) Explain why $h(t)$ is not a linear function.
- (c) What is the meaning of $h(0) = 25$?
- A. the initial height of the water balloon is 25 meters.
 - B. the water balloon reaches a maximum height of 25 meters.
 - C. the water balloon hits the ground after 25 seconds.
 - D. the water balloon travels 25 meters before hitting the ground.
- (d) Find the vertex of the quadratic function.
- A. $(0, 25)$
 - B. $(2, 45)$
 - C. $(5, 0)$
 - D. $(1, 40)$
- (e) What is the meaning of the vertex?
- A. The water balloon reaches a maximum height of 25 meters at the start.
 - B. After 2 seconds, the water balloon reaches a maximum height of 45 meters.
 - C. After 5 seconds, the water balloon reaches a maximum height.
 - D. After 1 second, the water balloon reaches a maximum height of 40 meters.

1.2.2 Videos

It would be great to include videos down here, like in the Calculus book!

1.3 Polynomial Long Division (PR3)

Objectives

- Rewrite a rational function as a polynomial plus a proper rational function.

1.3.1 Activities

Activity 1.3.1 Using long division, find the quotient and remainder for the given rational function. Rewrite the function as a polynomial plus a proper rational function, given $f(x) = \frac{3x^5 - 5x^2 + 2}{x^2 + x - 1}$.

- (a) What is the quotient?
- (b) What is the remainder?
- (c) What is the divisor?
- (d) Write the rational function as a polynomial plus a proper rational function.

- (e) How can you check your answer? (Hint: Think of regular long division with positive integers.)

1.3.2 Videos

It would be great to include videos down here, like in the Calculus book!

1.4 Zeroes of Polynomial Functions (PR4)

Objectives

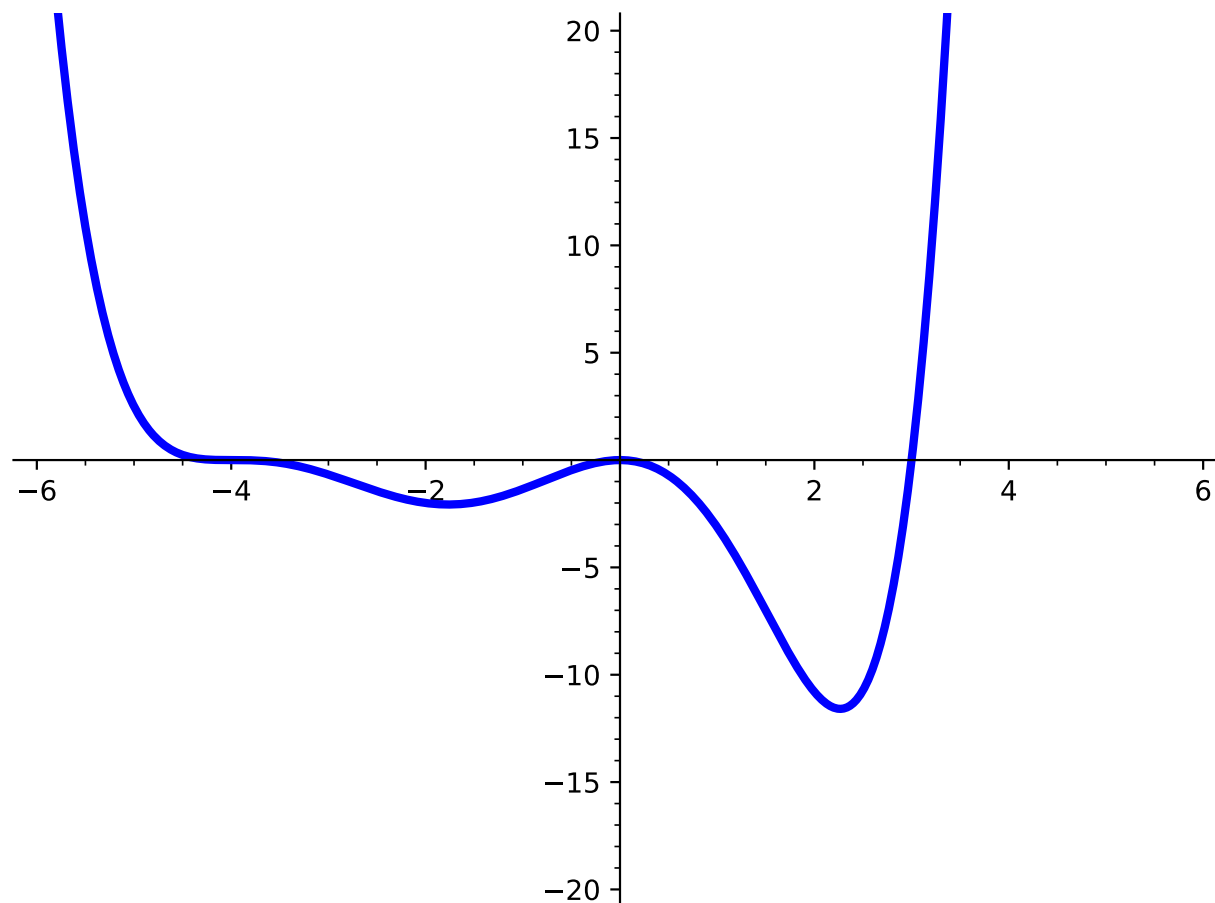
- Determine the zeros of a real polynomial function, write a polynomial function given information about its zeros and their multiplicities, and apply the Factor Theorem and the Fundamental Theorem of Algebra.

1.4.1 Activities

Theorem 1.4.1 Factor Theorem. *A number c is a zero of a polynomial function $f(x)$ if and only if $x-c$ is a factor of $f(x)$.*

Theorem 1.4.2 Fundamental Theorem of Algebra. *A polynomial function f of degree $n > 0$ has at least one zero.*

Activity 1.4.3 Write the polynomial function in factored form using information from the graph below.

**Figure 1.4.4**

(a) Using the given graph, what are the real zeros of this function? Select all that apply.

- A. 0
- B. 1
- C. -3
- D. 3
- E. 4
- F. -4

(b) What are the least possible multiplicities for each zero?

(c) What is the least degree of the function?

- A. 3
- B. 4
- C. 5
- D. 6

- (d) Describe the end behavior of the graph.
- A. As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
 - B. As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
 - C. As $x \rightarrow \infty$, $f(x) \rightarrow -\infty$
 - D. As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$
- (e) Combining the information in part (d) with the degree of the function, will the leading coefficient be positive or negative?
- A. positive
 - B. negative
- (f) Given the point $(2, \frac{-54}{5})$ is on the curve, and using the information in parts (a) through (e), write the function for the graph above in factored form.

1.4.2 Videos

It would be great to include videos down here, like in the Calculus book!

1.5 Graphs of Polynomial Functions (PR5)

Objectives

- Find the intercepts, estimated locations of maxima and minima, and end behavior of a polynomial function, and use this information to sketch the graph.

1.5.1 Activities

Activities go here! Don't forget to put text in <p> tags or it won't show up.

Activity 1.5.1 Activities may start with an <introduction>.

(a) Then we can ask students to do some <task>s.

(b) Here's a second <task>.

1.5.2 Videos

It would be great to include videos down here, like in the Calculus book!

1.6 Properties of Graphs of Rational Functions (PR6)

Objectives

- Find the domain and range, vertical and horizontal asymptotes, and intercepts of a rational function and use this information to sketch the graph.

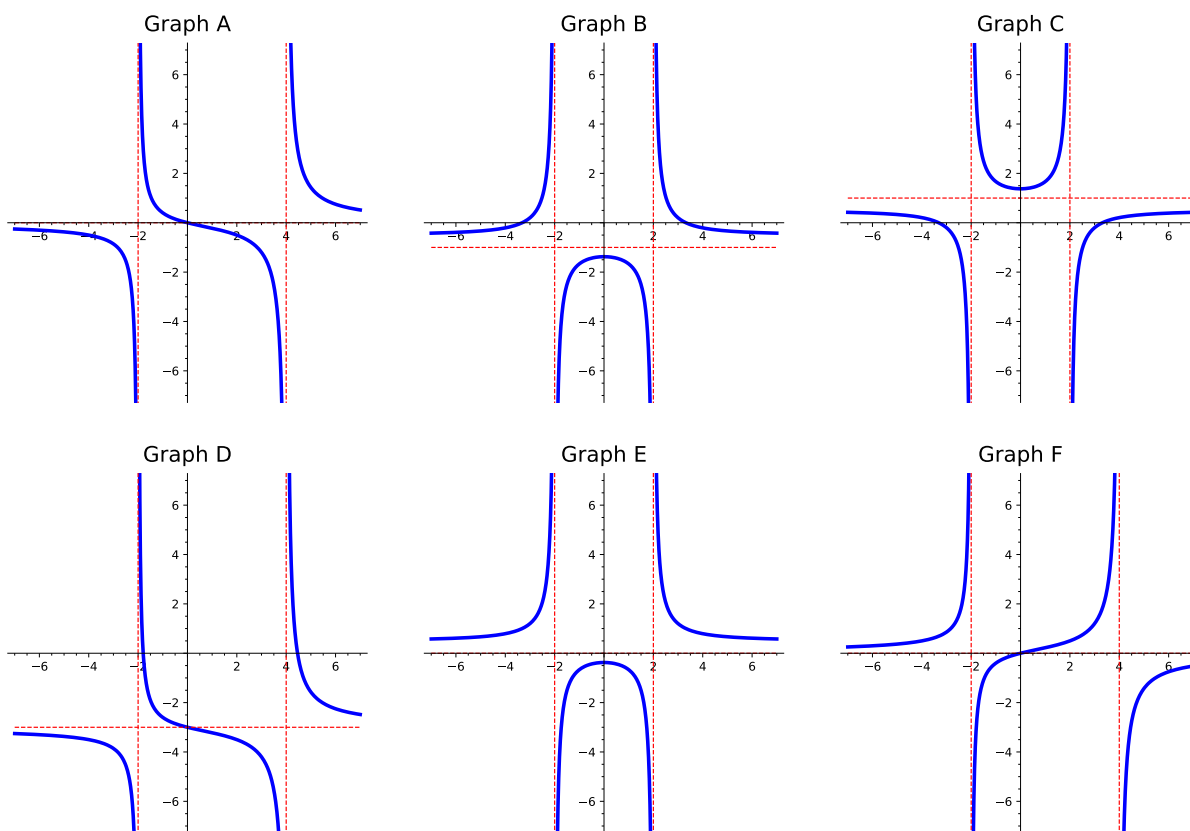
1.6.1 Activities

Definition 1.6.1 A function r is rational provided that it is possible to write r as the ratio of two polynomials, p and q . That is, r is rational provided that for some polynomial functions p and q , we have

$$r(x) = \frac{p(x)}{q(x)}.$$

◇

Activity 1.6.2 Consider the following six graphs of rational functions:



(a) Which of the graphs above represents the function $f(x) = \frac{2x}{x^2 - 2x - 8}$?

(b) Which of the graphs above represents the function $g(x) = \frac{x^2 + 3}{2x^2 - 8}$?

1.6.2 Videos

It would be great to include videos down here, like in the Calculus book!

Colophon

This book was authored in PreTeXt.