

4.4

Factoring Polynomials

For use with Exploration 4.4

Essential Question How can you factor a polynomial?

1 **EXPLORATION:** Factoring Polynomials

Work with a partner. Match each polynomial equation with the graph of its related polynomial function. Use the x -intercepts of the graph to write each polynomial in factored form. Explain your reasoning.

a. $x^2 + 5x + 4 = 0$

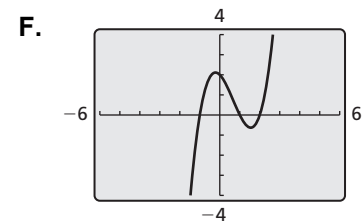
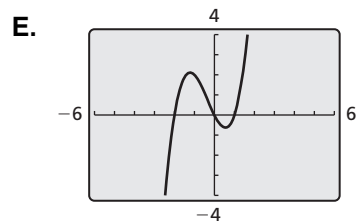
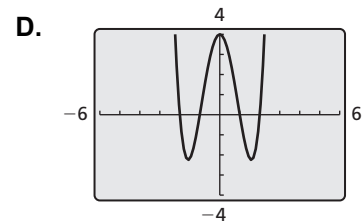
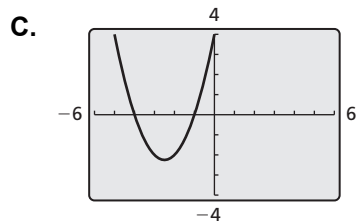
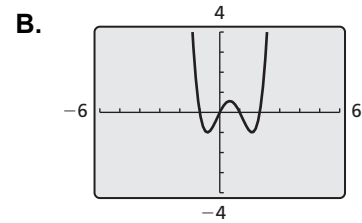
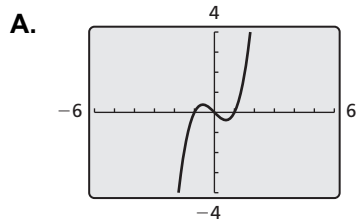
b. $x^3 - 2x^2 - x + 2 = 0$

c. $x^3 + x^2 - 2x = 0$

d. $x^3 - x = 0$

e. $x^4 - 5x^2 + 4 = 0$

f. $x^4 - 2x^3 - x^2 + 2x = 0$



4.4 Factoring Polynomials (continued)**2 EXPLORATION: Factoring Polynomials**

Work with a partner. Use the x -intercepts of the graph of the polynomial function to write each polynomial in factored form. Explain your reasoning. Check your answers by multiplying.

a. $f(x) = x^2 - x - 2$

b. $f(x) = x^3 - x^2 - 2x$

c. $f(x) = x^3 - 2x^2 - 3x$

d. $f(x) = x^3 - 3x^2 - x + 3$

e. $f(x) = x^4 + 2x^3 - x^2 - 2x$

f. $f(x) = x^4 - 10x^2 + 9$

Communicate Your Answer

- How can you factor a polynomial?
- What information can you obtain about the graph of a polynomial function written in factored form?

4.4**Notetaking with Vocabulary**

For use after Lesson 4.4

In your own words, write the meaning of each vocabulary term.

factored completely

factor by grouping

quadratic form

Core Concepts**Special Factoring Patterns****Sum of Two Cubes**

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

Example

$$\begin{aligned} 64x^3 + 1 &= (4x)^3 + 1^3 \\ &= (4x + 1)(16x^2 - 4x + 1) \end{aligned}$$

Difference of Two Cubes

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

Example

$$\begin{aligned} 27x^3 - 8 &= (3x)^3 - 2^3 \\ &= (3x - 2)(9x^2 + 6x + 4) \end{aligned}$$

Notes:

4.4 Notetaking with Vocabulary (continued)**The Factor Theorem**

A polynomial $f(x)$ has a factor $x - k$ if and only if $f(k) = 0$.

Notes:

Extra Practice

In Exercises 1–14, factor the polynomial completely.

1. $20x^3 - 220x^2 + 600x$

2. $m^5 - 81m$

3. $27a^3 + 8b^3$

4. $5t^6 + 2t^5 - 5t^4 - 2t^3$

5. $y^4 - 13y^2 - 48$

6. $5p^3 + 5p - 5p^2 - 5$

7. $810k^4 - 160$

8. $a^5 + a^3 - a^2 - 1$

4.4 Notetaking with Vocabulary (continued)

9. $2x^6 - 8x^5 - 42x^4$

10. $5z^3 + 5z^2 - 6z - 6$

11. $12x^2 - 22x - 20$

12. $3m^2 - 48m^6$

13. $4x^3 - 4x^2 + x$

14. $5m^4 - 70m^3 + 245m^2$

In Exercises 15–17, show that the binomial is a factor of the polynomial. Then factor the function completely.

15. $f(x) = x^3 - 13x - 12; x + 1$

16. $f(x) = 6x^3 + 8x^2 - 34x - 12; x - 2$

17. $f(x) = 2x^4 - 12x^3 + 6x^2 + 20x; x - 5$