7.8 Start Thinking

Copy and complete the table below by putting a check mark next to the type of factoring that applies to the polynomial.

Polynomial	GCF	$x^2 + bx + c$	$ax^2 + bx + c$	Difference of Squares
$8x^2 + 20x + 48$				
$x^2 - 19x + 48$				
$x^2 - 16$				
$6x^2 + 19x + 8$				

Is it possible to use more than one factoring technique to factor a polynomial? Explain.

7.8 Warm Up

Use mental math to simplify.

1. $35 + 20 + 5$

2. $15 \bullet 7 \bullet 2$

3. $1 + 5 + 4 + 8$

4. $5 \bullet 9 \bullet 3 \bullet 2$

5. $6 \bullet 8 \bullet 5$

6. $2 + 5 + 6 + 12$

7.8 Cumulative Review Warm Up

Evaluate the expression.

1. $64^{1/6}$

2. $(-27)^{2/3}$

3. $(256)^{3/8}$

4. $\left(\sqrt{4}\right)^2$

5. $(-64)^{4/3}$

6. $216^{1/3}$

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7.8 Practice A

In Exercises 1–4, factor the polynomial by grouping.

1. $x^3 - 3x^2 + x - 3$

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

3. $2y^3 - 2y^2 + 3y - 3$

4. $3p^3 + 5p^2 - 12p - 20$

In Exercises 5–10, factor the polynomial completely.

5. $4y^3 - 36y$

6. $3r^2 - 8r + 7$

7. $3t^3 + 12t^2 + 12t$

8. $-6q^3 + 28q^2 + 10q$

9. $5y^5 - 5y^4 - 10y^3$

10. $7x^2 + 21x + 7$

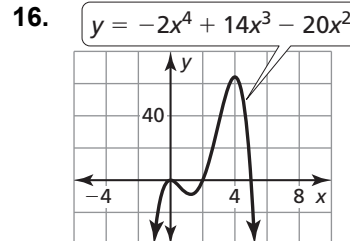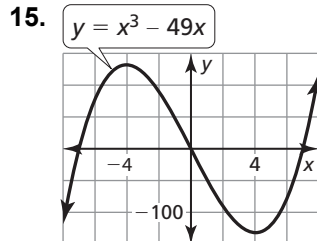**In Exercises 11–14, solve the equation.**

11. $3j^3 + 21j^2 + 30j = 0$

12. $w^4 - 36w^2 = 0$

13. $y^3 - 2y^2 - 9y + 18 = 0$

14. $5t^5 + 5t^4 - 210t^3 = 0$

In Exercises 15 and 16, find the *x*-coordinates of the points where the graph crosses the *x*-axis.

15.

$y = x^3 - 49x$

16.

$y = -2x^4 + 14x^3 - 20x^2$

17. A rectangular box has a volume of 105 cubic centimeters. The width of the rectangular box is x centimeters, the length is $(2x - 3)$ centimeters, and the height is 3 centimeters.

   a. Write a polynomial that represents the volume of the rectangular box.

   b. What are the dimensions of the rectangular box?

In Exercises 18 and 19, factor the polynomial completely.

18. $a^3 - 4a + 3a^2b - 12b$

19. $9g^3 - g - 18g^2h + 2h$

Name _____ Date _____

7.8 Practice B

In Exercises 1–4, factor the polynomial by grouping.

1. $a^2 - 3a + ab - 3b$

2. $m^2 + 7mn + 2m + 14n$

3. $t^2 - 4t + tv - 4v$

4. $3x^2 - 4x + 9xy - 12y$

In Exercises 5–10, factor the polynomial completely.

5. $45y^4 - 20y^2$

6. $8w^5 - 48w^4 + 72w^3$

7. $p^3 - 3p^2 - 16p + 48$

8. $12z^2 - 6z + 42$

9. $-21h^4 + 77h^3 + 28h^2$

10. $x^3 + 2x^2 - 49x - 98$

In Exercises 11–14, solve the equation.
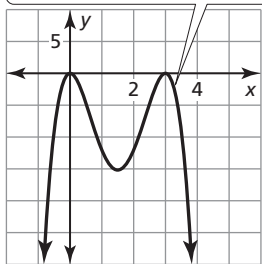
11. $p^3 + 2p^2 - 9p - 18 = 0$

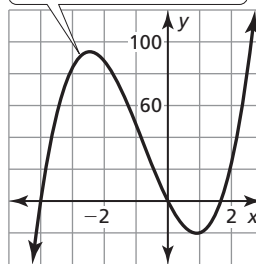12. $3y^4 + 9y^3 - 120y^2 = 0$

13. $36t - 4t^3 = 0$

14. $3q^3 - 5q^2 - 27q + 45 = 0$

In Exercises 15 and 16, find the *x*-coordinates of the points where the graph crosses the *x*-axis.

15. $y = -3x^4 + 18x^3 - 27x^2$

16. $y = 6x^3 + 14x^2 - 40x$

17. A rectangular box has a volume of $72x$ cubic inches. The width of the rectangular box is x inches, the length is $3x$ inches, and the height is $(3x - 1)$ inches.

    a. Write a polynomial that represents the volume of the rectangular box.

    b. What are the dimensions of the rectangular box?

In Exercises 18 and 19, factor the polynomial completely.

18. $5x^2 + 35xy - 2x - 14y$

19. $5p^3 + p^2q - 15pq - 3q^2$

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Quadratic Form $ax^{2n} + bx^n + c$

Factoring polynomials in quadratic form uses the same methods you know from factoring quadratic polynomials, only you must now take higher powers into consideration.

Example: Factor $2x^4 - x^2 - 1$.

$2x^4 - x^2 - 1 = 2x^4 - 2x^2 + x^2 - 1$	Rewrite the x-term as the sum of two terms whose coefficients have product ac and sum b.
$= (2x^4 - 2x^2) + (x^2 - 1)$	Group terms with common factors.
$= 2x^2(x^2 - 1) + 1(x^2 - 1)$	Factor GCF out of each pair of terms.
$= (2x^2 + 1)(x^2 - 1)$	Distributive Property
$= (2x^2 + 1)(x + 1)(x - 1)$	Difference of two squares pattern

In Exercises 1–10, factor completely.

1. $x^6 + 11x^3 + 30$

2. $y^4 - 5y^2 + 4$

3. $3p^8 + 4p^4 - 4$

4. $4x^4 + 3x^2 - 1$

5. $x^4 - 2x^2 + 1$

6. $-x^{10} - 7x^5 - 10$

7. $8u^6 + 10u^3 + 3$

8. $d^6 - 9d^3 + 14$

9. $-2t^8 + 7t^4 + 4$

10. $x^8 - 1$

7.8 Puzzle Time

What Do You Get When You Cross A Computer With A Freezer?

Write the letter of each answer in the box containing the exercise number.

Factor the polynomial completely.

1. $x^3 - 3x^2 + 4x - 12$

2. $6x^3 - 30x^2 + 7x - 35$

3. $x^2 + 2xy + 9x + 18y$

4. $x^2 - 8x + xy - 8y$

5. $4x^3 - 400x$

6. $3x^3 + 36x^2 + 108x$

7. $6x^5 + 6x^4 - 36x^3$

8. $-8x^4 + 24x^3 - 88x^2$

9. $x^3 - 8x^2 - 16x + 128$

10. $-7x^3 - 14x^2 - 7x$

Solve the equation.

11. $3x^2 - 18x + 15 = 0$

12. $x^3 + 2x^2 - 36x - 72 = 0$

13. $63x - 7x^3 = 0$

14. $8x^3 - 3x^2 = 32x - 12$

15. The volume of a box is 30 cubic inches. The width of the box is 2 inches less than the length. The height is 3 inches less than the length. Find the length of the box.

Answers

O. $4x(x + 10)(x - 10)$

L. $(x - 5)(6x^2 + 7)$

R. $(x + 4)(x - 4)(x - 8)$

S. $(x + y)(x - 8)$

W. $-7x(x + 1)^2$

E. $(x^2 + 4)(x - 3)$

A. $6x^3(x + 3)(x - 2)$

Y. $3x(x + 6)^2$

S. $-8x^2(x^2 - 3x + 11)$

E. $(x + 9)(x + 2y)$

V. $-3, 0, 3$ **R.** 5

C. $1, 5$ **O.** $-2, \dfrac{3}{8}, 2$

N. $-6, -2, 6$

13	1	9	6		11	5	14	2		7	12	8	10	3	15	4