Hello Everyone,

I am excited to have you in class this coming school year! I love math and working with students to help them understand and enjoy working with math.

This is the summer work for Precalculus Honors. They are practice problems for concepts that I hope you recall from Algebra I and II. These are concepts you need for Precalculus.

My expectation for the year is that, as honors students, if you do not know how to do a problem, you do your best to find out how to do it. You have several resources available to you online including khanacademy.org and google.com. If you get stuck, check out an online source.

When school starts, I will spend the first two classes answering any questions you have on the summer work. On the third day of class I will give a test on the summer work that covers the same types of problems to see where you stand.

Good luck and I look forward to working with you!

Mr. Killheffer

NOTE: The answers to the odd-numbered problems and partial worked out solutions can be found on calcchat.com for the Precalculus, 9th edition. Now and during the year, I assign odd-numbered problems because the answers are in the back of the book. I do this so you can see if you are getting the problems right so you can make sure you are doing the problems correctly. Your number one job is to understand the material. If frequently say in class, “Your goal is not to get it done…. It's to get it.” Needless to say, copying answers is not getting it. When I look at your work, I will always give you honest feedback on how well you get it.
Vocabulary: Fill in the blanks.
1. In the exponential form $a^n$, $n$ is the ______ and $a$ is the ______.
2. A convenient way of writing very large or very small numbers is called ______ ______.
3. One of the two equal factors of a number is called a ______ ______ of the number.
4. In the radical form $\sqrt[n]{a}$, the positive integer $n$ is the ______ of the radical and the number $a$ is the ______.
5. Radical expressions can be combined (added or subtracted) when they are ______ ______.
6. The expressions $a + b\sqrt{m}$ and $a - b\sqrt{m}$ are ______ of each other.
7. The process used to create a radical-free denominator is known as ______ the denominator.
8. In the expression $b^{m/n}$, $m$ denotes the ______ to which the base is raised and $n$ denotes the ______ or root to be taken.

Skills and Applications

Evaluating Exponential Expressions  In Exercises 9–14, evaluate each expression.
9. (a) $3 \cdot 3^3$  (b) $\frac{3^2}{3^4}$
10. (a) $(3^3)^0$  (b) $-3^2$
11. (a) $(2^3 \cdot 3^2)^2$  (b) $\left(-\frac{3}{4}\right)^3$
12. (a) $\frac{3}{3-4}$  (b) $48(-4)^3$
13. (a) $\frac{2 \cdot 3-2}{2^2 \cdot 3^{-1}}$  (b) $(-2)^3$
14. (a) $3^{-1} + 2^{-2}$  (b) $(-3)^2$

Evaluating an Algebraic Expression  In Exercises 15–20, evaluate the expression for the given value of $x$.
15. $-3x^4$, $x = 2$  16. $7x^{-2}$, $x = 4$
17. $6x^0$, $x = 10$  18. $2x^3$, $x = -3$
19. $-3x^4$, $x = -2$  20. $12(-x)^3$, $x = -\frac{1}{3}$

Using Properties of Exponents  In Exercises 21–26, simplify each expression.
21. (a) $(-5x)^3$  (b) $5x^4(x^2)$
22. (a) $(3x)^2$  (b) $(4x)^3$, $x \neq 0$
23. (a) $6y^2(2y)^3$  (b) $(-2)^3(3e^4)$
24. (a) $\frac{7x^2}{x^3}$  (b) $12(x + y)^3$
25. (a) $\left(\frac{x}{y}\right)^4$  (b) $\left(\frac{b-h}{a}\right)^2$
26. (a) $\left[(2x^2y^3)^{-1}\right]^{-1}$  (b) $\left(\frac{5x^2y^3}{x^2y^3}\right)^{-3}$

Rewriting with Positive Exponents  In Exercises 27–30, rewrite each expression with positive exponents and simplify.
27. (a) $(x + 5)^0$, $x \neq -5$  (b) $(2x^2)^{-2}$
28. (a) $(4y^{-2})(8y^4)$  (b) $(z + 2)^{-3}(z + 2)^{-1}$
29. (a) $\left(\frac{x^{-2}y^3}{5}\right)^{-2}$  (b) $\left(\frac{a^{-2}}{b^{-2}}\right)^3$
30. (a) $3^n \cdot 3^{2n}$  (b) $\frac{x^2 \cdot x^n}{x^3 \cdot x^3}$

Scientific Notation  In Exercises 31–34, write the number in scientific notation.
31. $10,250.4$  32. $-0.000125$
33. One micron (millionth of a meter): $0.000003937$ inch
34. Land area of Earth: $57,300,000$ square miles

Decimal Notation  In Exercises 35–38, write the number in decimal notation.
35. $3.14 \times 10^{-4}$  36. $-1.801 \times 10^4$
37. Light year: $9.46 \times 10^{12}$ kilometers
38. Width of a human hair: $9.0 \times 10^{-5}$ meter

Using Scientific Notation  In Exercises 39 and 40, evaluate each expression without using a calculator.
39. (a) $(2.0 \times 10^3)(3.4 \times 10^{-4})$  (b) $1.2 \times 10^3(5.0 \times 10^{-3})$
40. (a) $\frac{6.0 \times 10^8}{3.0 \times 10^{-3}}$  (b) $2.5 \times 10^{-3}$

Evaluating Expressions Involving Radicals  In Exercises 41 and 42, evaluate each expression without using a calculator.
41. (a) $\sqrt{9}$  (b) $\frac{\sqrt{2}}{8}$
42. (a) $\sqrt{27}$  (b) $\sqrt{36}$

Using Properties of Radicals  In Exercises 43 and 44, use the properties of radicals to simplify each expression.
43. (a) $\left(\frac{3}{2}\right)^3$  (b) $\sqrt[3]{32x^6}$
44. (a) $\sqrt[3]{12} \cdot \sqrt[3]{3}$  (b) $\sqrt[3]{(3x^2)^3}$
A.3 Exercises

Vocabulary: Fill in the blanks.

1. For the polynomial \( a_nx^n + a_{n-1}x^{n-1} + \cdots + a_1x + a_0 \), the degree is ________, the leading coefficient is ________, and the constant term is ________.

2. A polynomial with one term is called a ________, while a polynomial with two terms is called a ________, and a polynomial with three terms is called a ________.

3. To add or subtract polynomials, add or subtract the ________ ________ by adding their coefficients.

4. The letters in “FOIL” stand for the following. F ________ O ________ I ________ L ________

5. The process of writing a polynomial as a product is called ________.

6. A polynomial is ________ ________ when each of its factors is prime.

7. A ________ ________ ________ is the square of a binomial, and it has the form \( u^2 + 2uv + v^2 \) or \( u^2 - 2uv + v^2 \).

8. When a polynomial has more than three terms, a method of factoring called ________ ________ may be used.

Skills and Applications

Polynomials In Exercises 9–18, (a) write the polynomial in standard form, (b) identify the degree and leading coefficient of the polynomial, and (c) state whether the polynomial is a monomial, a binomial, or a trinomial.

9. \( 14x - \frac{1}{3}x^5 \)  
10. \( 7x \)  
11. \( 3 - x^6 \)  
12. \( -y + 25y^2 + 1 \)  
13. \( 3 \)  
14. \( -8 + i^2 \)  
15. \( 1 + 6x^4 - 4x^3 \)  
16. \( 3 + 2x \)  
17. \( 4x^3y \)  
18. \( -x^2y + 2x^2y^2 + xy^4 \)

Operations with Polynomials In Exercises 19–26, perform the operation and write the result in standard form.

19. \( (6x + 5) - (8x + 15) \)  
20. \( (2x^2 + 1) - (x^2 - 2x + 1) \)  
21. \( (15x^2 - 6) - (-8.3x^3 - 14.7x^2 - 17) \)  
22. \( (15.6x^4 - 14w - 17.4) - (16.9w^4 - 9.2w + 13) \)  
23. \( 3x^3 - 2x + 1 \)  
24. \( y^3(4y^2 + 2y - 3) \)  
25. \( -5x(3x - 1) \)  
26. \( -3x(5x + 2) \)

Multiplying Polynomials In Exercises 27–40, multiply or find the special product.

27. \( (x + 3)(x + 4) \)  
28. \( (x - 5)(x + 10) \)  
29. \( (x^2 - x + 1)(x^2 + x + 1) \)  
30. \( (2x^2 - x + 4)(x^2 + 3x + 2) \)  
31. \( (x + 10)(x - 10) \)  
32. \( (4a + 5b)(4a - 5b) \)  
33. \( (2x + 3)^2 \)  
34. \( (8x + 3)^2 \)  
35. \( (x + 1)^3 \)  
36. \( (3x + 2y)^3 \)

37. \( (m - 3) + n[(m - 3) - n] \)  
38. \( (x + 3y) + z[(x - 3y) - z] \)  
39. \( (x + 3 + y)^2 \)  
40. \( (x + 1 - y)^2 \)

Factoring Out a Common Factor In Exercises 41–44, factor out the common factor.

41. \( 2x^2 - 6x \)  
42. \( 3z^2 - 6z^2 + 9z \)  
43. \( 3x(x - 5) + 8(x - 5) \)  
44. \( (x + 3)^2 - 4(x + 3) \)

Greatest Common Factor In Exercises 45–48, find the greatest common factor such that the remaining factors have only integer coefficients.

45. \( \frac{1}{3}x^3 + 2x^2 - 5x \)  
46. \( \frac{1}{2}x^4 - 5y^2 + 2y \)  
47. \( \frac{1}{3}x(x - 3) - 4(x - 3) \)  
48. \( \frac{2}{3}y(y + 1) - 2(y + 1) \)

Factoring the Difference of Two Squares In Exercises 49–52, completely factor the difference of two squares.

49. \( x^2 - 81 \)  
50. \( z^2 - 64 \)  
51. \( (x - 1)^2 - 4 \)  
52. \( 25 - (z + 5)^2 \)

Factoring a Perfect Square Trinomial In Exercises 53–58, factor the perfect square trinomial.

53. \( x^2 - 4x + 4 \)  
54. \( 4r^2 + 4r + 1 \)  
55. \( 9u^2 + 24uv + 16v^2 \)  
56. \( 36y^2 - 108y + 81 \)  
57. \( z^2 + z + \frac{1}{4} \)  
58. \( 9y^2 - \frac{1}{2}y + \frac{1}{16} \)

Factoring the Sum or Difference of Cubes In Exercises 59–62, factor the sum or difference of cubes.

59. \( x^3 - 8 \)  
60. \( 27 - x^3 \)  
61. \( 27x^3 + 8 \)  
62. \( u^3 + 27v^3 \)
Vocabulary: Fill in the blanks.

1. The set of real numbers for which an algebraic expression is defined is the ________ of the expression.
2. The quotient of two algebraic expressions is a fractional expression, and the quotient of two polynomials is a ________ ________.
3. Fractional expressions with separate fractions in the numerator, denominator, or both are called ________ fractions.
4. Two algebraic expressions that have the same domain and yield the same values for all numbers in their domains are called ________.

Skills and Applications

Finding the Domain of an Algebraic Expression

In Exercises 5–16, find the domain of the expression.

5. \(3x^2 - 4x + 7\)
6. \(6x^2 - 9, \quad x > 0\)
7. \(\frac{1}{3 - x}\)
8. \(\frac{x + 6}{3x + 2}\)
9. \(\frac{x^2 - 1}{x^2 - 2x + 1}\)
10. \(\frac{x^2 - 5x + 6}{x^2 - 4}\)
11. \(\frac{x^2 - 2x - 3}{x^2 - 6x + 9}\)
12. \(\frac{x^2 - x - 12}{x^2 - 8x + 16}\)
13. \(\sqrt{4 - x}\)
14. \(\sqrt{2x - 5}\)
15. \(\frac{1}{\sqrt{x} - 3}\)
16. \(\frac{1}{\sqrt{x} + 2}\)

Simplifying a Rational Expression

In Exercises 17–30, write the rational expression in simplest form.

17. \(\frac{15x^2}{10x}\)
18. \(\frac{18y^2}{60y^2}\)
19. \(\frac{3xy}{xy + x}\)
20. \(\frac{4y - 8y^2}{10y - 5}\)
21. \(\frac{x - 5}{10 - 2x}\)
22. \(\frac{12 - 4x}{x - 3}\)
23. \(\frac{y^2 - 16}{y + 4}\)
24. \(\frac{x^2 - 25}{5 - x}\)
25. \(\frac{x^3 + 5x^2 + 6x}{x^2 - 4}\)
26. \(\frac{x^3 + 8x - 20}{x^2 + 11x + 10}\)
27. \(\frac{2 - x + 2x^2 - x^3}{x^2 - 4}\)
28. \(\frac{y^3 - 2y^2 - 3y}{y^3 + 1}\)
29. \(\frac{z^2 - 8}{z^2 + 2z + 4}\)
30. \(\frac{5x^3}{2x^3 + 4} \quad 5 \times 6 = \frac{5}{2} + 4 = \frac{6}{2} + 4 = \frac{3}{2} + 4 = 5\)

31. Error Analysis

Describe the error.

32. Evaluating a Rational Expression

Complete the table. What can you conclude?

<table>
<thead>
<tr>
<th>(x)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\frac{x - 3}{x^2 - x - 6})</td>
<td>(\frac{1}{x + 2})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multiplying or Dividing Rational Expressions

In Exercises 33–38, perform the multiplication or division and simplify.

33. \(\frac{5}{x - 1} \times \frac{x - 1}{25(x - 2)}\)
34. \(\frac{r - 1}{r^2} \div \frac{r^2}{r - 1}\)
35. \(\frac{4y - 16}{5y + 15} \div \frac{4 - y}{2y + 6}\)
36. \(\frac{t^2 - t - 6}{t^2 + 6t + 9} \div \frac{t + 3}{t^2 - 4}\)
37. \(\frac{x^2 + xy - 2y^2}{x^3 + x^2y} \div \frac{x}{x^2 + 3xy + 2y^2}\)
38. \(\frac{x^2 - 14x + 49}{x^2 - 49} \div \frac{3x - 21}{3x + 7}\)

Adding or Subtracting Rational Expressions

In Exercises 39–46, perform the addition or subtraction and simplify.

39. \(6 - \frac{5}{x + 3}\)
40. \(\frac{2x - 1}{x + 3} + \frac{1 - x}{x + 3}\)
41. \(\frac{3}{x - 2} + \frac{5}{2 - x}\)
42. \(\frac{2x}{x - 5} - \frac{5}{5 - x}\)
43. \(\frac{4}{2x + 1} - \frac{x}{x + 2}\)
44. \(\frac{1}{x^2 - x - 2} - \frac{x}{x^2 - 5x + 6}\)
45. \(\frac{1}{x} + \frac{2}{x^2 + 1} + \frac{1}{x^3 + x}\)
46. \(\frac{2}{x + 1} + \frac{2}{x - 1} + \frac{1}{x^2 - 1}\)
A.5 Exercises

Vocabulary: Fill in the blanks.
1. An ________ is a statement that equates two algebraic expressions.
2. A linear equation in one variable \( x \) is an equation that can be written in the standard form ________.
3. An ________ solution is a solution that does not satisfy the original equation.
4. Four methods that can be used to solve a quadratic equation are ________, extracting ________, ________, the ________, and the ________.

Skills and Applications

Solving a Linear Equation In Exercises 5–12, solve the equation and check your solution. (If not possible, explain why.)

5. \( x + 11 = 15 \)
6. \( 7 - x = 19 \)
7. \( 7 - 2x = 25 \)
8. \( 3x - 5 = 2x + 7 \)
9. \( 4y + 2 - 5y = 7 - 6y \)
10. \( 0.25x + 0.75(10 - x) = 3 \)
11. \( x - 3(2x + 3) = 8 - 5x \)
12. \( 9x - 10 = 5x + 2(2x - 5) \)

Solving a Rational Equation In Exercises 13–24, solve the equation and check your solution. (If not possible, explain why.)

13. \( \frac{3x}{8} - \frac{4x}{3} = 4 \)
14. \( \frac{5x}{4} + \frac{1}{2} = x - \frac{1}{2} \)
15. \( \frac{5x - 4}{3x + 4} = \frac{2}{3} \)
16. \( \frac{10x + 3}{5x + 6} = \frac{1}{2} \)
17. \( 10 - \frac{13}{x} = 4 + \frac{5}{x} \)
18. \( \frac{1}{x} + \frac{2}{x - 5} = 0 \)
19. \( \frac{x}{x + 4} + \frac{4}{x + 4} + 2 = 0 \)
20. \( \frac{2}{2x + 1} - \frac{8x}{2x - 1} = -4 \)
21. \( \frac{2}{(x - 4)(x - 2)} = \frac{1}{x - 4} + \frac{2}{x - 2} \)
22. \( \frac{4}{x - 1} + \frac{6}{3x + 1} + \frac{15}{3x + 1} \)
23. \( \frac{1}{x - 3} + \frac{1}{x + 3} = \frac{10}{x^2 - 9} \)
24. \( \frac{1}{x - 2} + \frac{3}{x + 3} = \frac{4}{x^2 + x - 6} \)

Solving a Quadratic Equation by Factoring In Exercises 25–34, solve the quadratic equation by factoring.

25. \( 6x^2 + 3x = 0 \)
26. \( 9x^2 - 1 = 0 \)
27. \( x^2 - 2x - 8 = 0 \)
28. \( x^2 - 10x + 9 = 0 \)
29. \( x^2 + 10x + 25 = 0 \)
30. \( 4x^2 + 12x + 9 = 0 \)
31. \( x^2 + 4x = 12 \)
32. \( -x^2 + 8x = 12 \)
33. \( \frac{1}{4}x^2 + 8x + 20 = 0 \)
34. \( \frac{1}{3}x^2 - x - 16 = 0 \)

Extracting Square Roots In Exercises 35–42, solve the equation by extracting square roots. When a solution is irrational, list both the exact solution and its approximation rounded to two decimal places.

35. \( x^2 = 49 \)
36. \( x^2 = 32 \)
37. \( 3x^2 = 81 \)
38. \( 9x^2 = 36 \)
39. \( (x - 12)^2 = 16 \)
40. \( (x + 9)^2 = 24 \)
41. \( (2x - 1)^2 = 18 \)
42. \( (x - 7)^2 = (x + 3)^2 \)

Completing the Square In Exercises 43–50, solve the quadratic equation by completing the square.

43. \( x^2 + 4x - 32 = 0 \)
44. \( x^2 - 2x - 3 = 0 \)
45. \( x^2 + 6x + 2 = 0 \)
46. \( x^2 + 8x + 14 = 0 \)
47. \( 9x^2 - 18x = -3 \)
48. \( 7 + 2x - x^2 = 0 \)
49. \( 2x^2 + 5x - 8 = 0 \)
50. \( 3x^2 - 4x - 7 = 0 \)

Using the Quadratic Formula In Exercises 51–64, use the Quadratic Formula to solve the equation.

51. \( 2x^2 + x - 1 = 0 \)
52. \( 2x^2 - x - 1 = 0 \)
53. \( 2 + 2x - x^2 = 0 \)
54. \( x^2 - 10x + 22 = 0 \)
55. \( 2x^2 - 3x - 4 = 0 \)
56. \( 3x + x^2 - 1 = 0 \)
57. \( 12x - 9x^2 = -3 \)
58. \( 9x^2 - 37 = 6x \)
59. \( 9x^2 + 30x + 25 = 0 \)
60. \( 28x - 49x^2 = 4 \)
61. \( 8t = 5 + 2t^2 \)
62. \( 25b^2 + 80b + 61 = 0 \)
63. \( (y - 5)^2 = 2y \)
64. \( (z + 6)^2 = -2z \)