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Section 1

10.1	Fractional Exponents	2
10.2	Absolute Value Equations	6
10.3	Canceling in Unit Conversion	12
10.4	Graphing Absolute Value Inequalities	18
10.5	Quiz 1 ► Paths in the Seas	23

Section 2

10.6	Best Fit Lines and Extrapolation	24
10.7	The Discriminant of a Quadratic Equation	33
10.8	Multiplying and Dividing With Fractional Exponents	37
10.9	Longer Unit Conversions	42
10.10	Quiz 2 ► Just One More Foot, Please	47

Section 3

10.11	Probability	48
10.12	Applications Using Inequalities	52
10.13	Function Notation	57
10.14	Graphing a System With an Equation and an Inequality	61
10.15	Review for Test	66
10.16	Test ► Cartography: Four-Color Maps	69

Fractional Exponents

Normally roots are expressed using radical signs. However, roots can be expressed using fractional notation. To write a radical using a fractional exponent, write the power of the radicand as the numerator and the index in the radical as the denominator. The two terms below, one expressed using the radical sign and the other using a fractional exponent, are equal.

$$\sqrt[b]{x^a} = x^{\frac{a}{b}}$$

Example 1 Change radical to fractional notation: $\sqrt[3]{x^2}$.

$\sqrt[3]{x^2}$ Original problem.

$\sqrt[3]{x^2} = x^{\frac{2}{3}}$ Exponent is numerator.

$\sqrt[3]{x^2} = x^{\frac{2}{3}}$ Index is denominator.

Sometimes a fractional exponent can be reduced, and sometimes after being reduced, they can be simplified.

Example 2 Change radical to fractional notation: $\sqrt{8^4}$.

$\sqrt{8^4}$ Original problem.

$\sqrt{8^4} = 8^{\frac{4}{2}}$ Exponent is numerator.

$8^{\frac{4}{2}} = 8^2 = 64$ Index is denominator.

When there are two or more variables, each variable is converted to fractional notation.

$$\sqrt[5]{x^3y^2} = x^{\frac{3}{5}}y^{\frac{2}{5}} \quad \sqrt{xy} = x^{\frac{1}{2}}y^{\frac{1}{2}} \text{ or } (xy)^{\frac{1}{2}}$$

Math in History

On his first cruise as a midshipman aboard the frigate Brandywine, Matthew Maury attended school when he wasn't working. The navy's navigation textbook frustrated him—it was vague, incomplete, and didn't agree with other sources. Maury saw the need for a better system to prevent shipwrecks.

Today's Lesson

Change from radical to fractional notation. Simplify if possible.

1. $\sqrt{7}$

2. $\sqrt[3]{100}$

3. $\sqrt[3]{x^2}$

4. $\sqrt[5]{x^3}$

5. $\sqrt[3]{2^6}$

6. $\sqrt{a^3b^5}$

7. $\sqrt[4]{x^2y^3}$

8. $\sqrt{16^2a^3}$

The concept of fractional exponents works both ways. Terms with fractional exponents can be expressed with radical signs.

$$x^{\frac{2}{3}} = \sqrt[3]{x^2} \qquad 8^{\frac{1}{3}} = \sqrt[3]{8} = 2$$

Today's Lesson

Change from fractional notation to radical notation.

Simplify if possible.

9. $x^{\frac{3}{5}}$

10. $7^{\frac{1}{2}}$

11. $e^{\frac{1}{5}}$

12. $y^{\frac{2}{3}}$

13. $8^{\frac{2}{3}}$

14. $x^{\frac{7}{2}}$

15. $3^{\frac{3}{4}}$

16. $y^{\frac{4}{3}}$

17. $48^{\frac{1}{2}}$

REVIEW

Solve by using the quadratic formula. 9.14

18. $x^2 + 4x + 2 = 0$

19. $6x^2 - 5x + 1 = 0$

20. $16x^2 - 16x + 1 = 0$

Divide. 8.7

21. $(3w^2 + 4w - 4) \div (w + 2)$

22. $\frac{2b^2 + 7b - 12}{2b + 5}$

Factor the polynomials. 6.2, 6.7, 7.7

23. $3x^2 - 11x - 4$

24. $y^2 - 6y + 5$

25. $25x^2 + 2x + \frac{1}{25}$

Lesson 10.1

Factor the polynomials completely. 8.1

26. $2x^3y + 5x^2y - 3xy$

27. $3xy + 9x - 5y - 15$

28. $3r^2s^4 - 48r^2$

Solve the quadratic equations for x by taking the square root of both sides. 9.1

29. $4x^2 = 64$

30. $x^2 = 8$

31. $x^2 - 14x + 49 = 36$

Divide the rational expressions. 7.4

32. $\frac{2xy - 6y}{y - 4} \div \frac{x^2 - 6x + 9}{xy - 4x}$

33. $\frac{12x^2y}{11z} \div \frac{3x^2}{22zy}$

34. $\frac{x^2 - 3x}{4} \div \frac{xy - 3y}{8x + 2y}$

Simplify. 9.9

35. $\frac{\frac{4x^2}{4}}{\frac{2x^5}{3y^2}}$

36. $\frac{\frac{y-3}{y+2}}{\frac{5y-15}{4}}$

37. $\frac{x - \frac{1}{2}}{\frac{x}{3} + \frac{1}{4}}$

Solve. List any excluded value(s). 9.13

38. $\frac{x}{2} - \frac{5}{2} = \frac{4x}{3}$

39. $\frac{6x}{2x} + \frac{5x}{x-1} = \frac{2}{x-1}$

40. $\frac{x-1}{x-3} = \frac{x-4}{x+2}$

Find the LCD of each set of expressions. 8.8

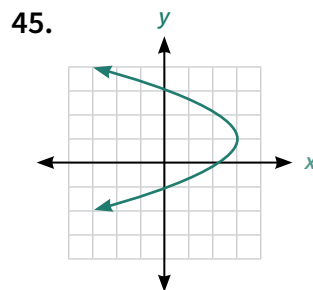
41. $\frac{4}{3y}$ and $\frac{5}{9y^3}$ and $\frac{7}{3xy^2}$

42. $\frac{5x}{2x^2 - 6x}$ and $\frac{3x^2}{4y^2 - 12y}$

43. $\frac{5x^2}{3x^2 - 48x}$ and $\frac{7x-1}{2x+32}$

Specify the domain and tell whether or not it represents a function. 9.12

44. $y = \sqrt{x} - 3$



Today's Lesson

Change from radical to exponential notation. Simplify if possible.

46. $\sqrt{5}$

47. $\sqrt[3]{17}$

48. \sqrt{a}

49. $\sqrt[6]{y^5}$

Change from exponential to radical notation. Simplify if possible.

50. $x^{\frac{2}{7}}$

51. $y^{\frac{3}{2}}$

52. $b^{\frac{2}{5}}$

53. $9^{\frac{2}{3}}$

Extra Practice

Change from radical to exponential notation. Simplify if possible.

54. $\sqrt{3}$

55. $\sqrt[3]{13}$

56. $\sqrt[5]{a^3}$

57. $\sqrt[6]{x}$

Change from exponential to radical notation. Simplify if possible.

58. $x^{\frac{3}{5}}$

59. $y^{\frac{5}{7}}$

60. $b^{\frac{3}{4}}$

61. $9^{\frac{2}{7}}$