Algebra 1 Name:

6.2 Explain – Radicals and Rational Exponents - Notes

Essential Question: How do you simplify expressions with rational exponents?

Main Ideas/ Questions	Notes/Examples
What You Will Learn	• Evaluate and simplify expressions with rational exponents. • Rewrite expressions in rational exponent form. • Solve real-life problems involving rational exponents.
What is a rational exponent?	**Definition:** An exponent that can be written as a..... ratio (fraction) • Rational Exponent Form: $a^{\frac{m}{n}}$ **Practice:** Using the calculator, evaluate the expressions. 1. $32^{\frac{2}{5}} = 4$ 2. $343^{\frac{2}{3}} = 49$ 3. $-729^{\frac{5}{6}} = -243$

Using the Laws of Exponents to Simplify Rational Exponents

Practice: Simplify the expressions. Use only positive exponents in your answer. (use calculator to Add fractions)

Multiply: (Multiply coefficients & Add exponents)

4. $5^{-\frac{3}{2}} \cdot 5^{\frac{7}{2}} =$
$5^{(-\frac{3}{2}+\frac{7}{2})}$
$= 5^2 = \boxed{25}$

5. $x^{\frac{1}{2}}(x^{\frac{1}{2}}) =$
$x^{(\frac{1}{2}+\frac{1}{2})}$
$= x^1 = \boxed{x}$

6. $2y^{\frac{3}{4}} \cdot 5y^{\frac{1}{2}} =$
$10y^{(\frac{3}{4}+\frac{1}{2})}$
$= \boxed{10y^{\frac{5}{4}}}$

7. $(2a^2b^{\frac{1}{4}})(-4a^{\frac{2}{3}}b^{\frac{1}{2}}) =$
$-8a^{(2+\frac{2}{3})}b^{(\frac{1}{4}+\frac{1}{2})}$
$= \boxed{-8a^{\frac{8}{3}}b^{\frac{3}{4}}}$

Divide: (Subtract exponents)

8. $\frac{12d^{\frac{1}{2}}}{4d^{\frac{3}{4}}} =$
$3d^{(\frac{1}{2}-\frac{3}{4})}$
$= 3d^{-\frac{1}{4}} = \boxed{\frac{3}{d^{\frac{1}{4}}}}$

9. $\frac{125^3}{125^{\frac{8}{3}}} =$
$= 125^{(3-\frac{8}{3})}$
$= \boxed{125^{\frac{1}{3}}}$

Exponent to Exponent: (Multiply exponents)

10. $(c^5d^{\frac{1}{2}})^3 =$
$\boxed{c^{15}d^{\frac{3}{2}}}$

11. $(16f^{\frac{1}{2}}g^{\frac{2}{3}})^{\frac{1}{2}} =$
$= 16^{\frac{1}{2}}f^{\frac{1}{4}}g^{\frac{1}{3}}$
$= \boxed{4f^{\frac{1}{4}}g^{\frac{1}{3}}}$

12. $(m^3)^{-1}(x^{\frac{1}{3}})^{\frac{1}{4}} =$
$= m^{-3}x^{\frac{1}{12}}$
$= \boxed{\frac{x^{\frac{1}{12}}}{m^3}}$

13. $\left(\frac{z^{\frac{2}{3}}}{5}\right)^3 =$
$\frac{z^2}{5^3} = \boxed{\frac{z^2}{125}}$

14. Find the area of the figure.

$A = lw$
$= (4x)^{\frac{3}{2}}(12x^{\frac{3}{4}})$
$= 4^{\frac{3}{2}}x^{\frac{3}{2}}12x^{\frac{3}{4}}$
$= 8x^{\frac{3}{2}}12x^{\frac{3}{4}} = \boxed{96x^{\frac{9}{4}}}$

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Rewriting Expressions in Rational Exponent Form

Property:

$a^{\frac{m}{n}} = \sqrt[n]{a^m}$

"e" (exponent)

"R" (root)

index →

Examples:

$\sqrt[3]{27^1} = 27^{1/3}$ $\quad \sqrt[2]{5^3} = 5^{3/2}$ $\quad (\sqrt[4]{x})^3 = x^{3/4}$

← "2" when a # is not there

Practice: Rewrite the expression in rational exponent form.

15. $\sqrt[2]{10^1} = 10^{1/2}$ 16. $\sqrt[5]{34^1} = 34^{1/5}$ 17. $\sqrt[3]{x^2} = x^{2/3}$

18. $\left(\sqrt[5]{4}\right)^3 = 4^{3/5}$ 19. $(\sqrt[5]{x})^3 = x^{3/5}$ 20. $(\sqrt[4]{x})^2 = x^{2/4} = x^{1/2}$

Practice: Simplify the expressions. Use only positive exponents in your answer.

21. $\frac{2w^{-2}\sqrt[3]{x^5}}{(2w)^2} = \frac{2x^{5/3}}{w^2 \cdot 2^2 w^2} = \frac{2x^{5/3}}{4w^4} = \boxed{\frac{x^{5/3}}{2w^4}}$

22. $\sqrt[3]{x^2}(x^3y^{-3}) = \frac{x^{2/3} \cdot x^3}{y^3} = \frac{x^{(\frac{2}{3}+3)}}{y^3} = \frac{x^{11/3}}{y^3}$

23. The radius r of a sphere is given by the equation $r = \left(\frac{A}{4\pi}\right)^{1/2}$ where A is the surface area of the sphere. The surface area of a sphere is 1493 square meters. Find the radius of the sphere to the nearest tenth of a meter. Use 3.14 for π.

$r = \left(\frac{1493}{4(3.14)}\right)^{1/2} = (118.9)^{1/2} = 10.9$ meters

24. Write the expression in exponential form. $2\sqrt[3]{a^1} + 3\sqrt[3]{a^1}$

$2a^{1/3} + 3a^{1/3} = 5a^{1/3}$

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6.2 Radicals and Rational Exponents

In Exercises 1 and 2, rewrite the expression in rational exponent form.

1. $\sqrt{7}$
2. $\sqrt[4]{13}$

In Exercises 3 and 4, rewrite the expression in radical form.

3. $14^{1/4}$
4. $117^{1/6}$

In Exercises 5 and 6, evaluate the expression.

5. $\sqrt[3]{-125}$
6. $\sqrt[4]{81}$

In Exercises 7 and 8, rewrite the expression in rational exponent form.

7. $\left(\sqrt[4]{14}\right)^3$
8. $\left(\sqrt[3]{-40}\right)^5$

In Exercises 9 and 10, rewrite the expression in radical form.

9. $10^{3/5}$
10. $(-3)^{6/5}$

In Exercises 11–13, evaluate the expression.

11. $81^{3/4}$
12. $25^{3/2}$
13. $(-27)^{2/3}$

14. The area of a square patio is 49^3 square inches. Find the length of one side of the patio.

In Exercises 15–28, simplify the expression. Write your answer using only positive exponents.

15. $3^{-2/3} \cdot 3^{7/3}$
16. $(-2x^3)(5x^{\frac{1}{2}})$
17. $m^{-7/6} \cdot m^{1/4}$
18. $a^{\frac{1}{3}}b^2(a^{\frac{2}{3}}b)$

19. $\dfrac{7^{\frac{3}{4}}}{7^{-\frac{5}{4}}}$
20. $20k^{\frac{5}{4}} \div 5k^{\frac{1}{2}}$
21. $\left(\frac{1}{9}\right)^{2/3} \cdot \left(\frac{1}{9}\right)^{5/6}$
22. $\left(x^{\frac{5}{6}}\right)^6$

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23. $(25x^2)^{\frac{1}{2}}$

24. $(ab)^{\frac{1}{3}}(b)^{\frac{1}{3}}$

25. $(p^{-3})^{\frac{2}{5}}$

26. $\left(x^{\frac{1}{2}}\right)^4 \sqrt[3]{x^3}$

27. $\dfrac{\left(x^{\frac{1}{2}}\right)^4}{\sqrt[4]{x^3}}$

28. $\dfrac{\sqrt[8]{x^{12}}}{\sqrt{x}}$

29. The radius of a sphere is given by the equation $r = \left(\dfrac{3V}{4\pi}\right)^{1/3}$, where V is the volume of the sphere. Find the radius, to the nearest centimeter, of a sphere that has a volume of 268 cubic centimeters. Use 3.14 for π.

30. A math club is having a bake sale. Find the area of the bake sale sign.

$4^{1/2}$ ft

$\sqrt[6]{729}$ ft

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