Explore: Rational Exponents

1. Fill in the table below using your calculator. (Math - Option 4)

$\sqrt[3]{8}$	2	$8^{\frac{1}{3}}$	2
$\sqrt[3]{64}$	4	$64^{\frac{1}{3}}$	4
$\sqrt[3]{125}$	5	$125^{\frac{1}{3}}$	5

What do you notice about the answers? They are the same

2. Fill in the table below using your calculator. (Root # - Math - Option 5)

$\sqrt[4]{16}$	2	$16^{\frac{1}{4}}$	2
$\sqrt[4]{256}$	4	$256^{\frac{1}{4}}$	4
$\sqrt[4]{625}$	5	$625^{\frac{1}{4}}$	5

What do you notice about the answers?

same

To Know:

$2^2, 2^3, 2^4, 2^5, 2^6, 2^7 \ldots$

$3^2, 3^3, 3^4, 3^5$

$4^2, 4^3, 4^4$

$5^2, 5^3, 5^4$

any you see on homework!

3. Based on these patterns, $x^{\frac{1}{3}} =$ $\sqrt[3]{x}$

The formula for this pattern is: $a^{\frac{1}{n}} = \sqrt[n]{a}$

4. What if we had fractions with numbers besides '1' in the numerator? For example, $9^{\frac{3}{2}}$.
   a. What does the "2" do in this problem based on the pattern we just discovered when a number is in the denominator of an exponent?

   b. So, your problem simplifies to $\left(\sqrt[2]{9}\right)^{3}$

   c. What does the "3" therefore do? exponent

   d. What is your final answer? $3^3 = \boxed{27}$

KEY CONCEPT: $a^{\frac{m}{n}} = (a^{\frac{1}{n}})^m = (\sqrt[n]{a})^m = \sqrt[n]{a^m}$

Fill in the following table.

Expression with rational exponent	Expression using radical notation
$x^{\frac{3}{4}}$	$(\sqrt[4]{x})^3$
$x^{3/5}$	$\left(\sqrt[5]{x}\right)^3$
$x^{\frac{5}{9}}$	$(\sqrt[9]{x})^5$
$x^{10/2}$ or x^5	$\left(\sqrt[2]{x}\right)^{10}$

Evaluate the following without using a calculator:

1. $16^{\frac{3}{2}}$ $\sqrt{16}^3 = 4^3 = \boxed{64}$

2. $8^{\frac{2}{3}}$ $(\sqrt[3]{8})^2 = 2^2 = \boxed{4}$

3. $\left(\sqrt[4]{16}\right)^7$ $2^7 = \boxed{128}$

4. $4^{\frac{3}{2}}$ $(\sqrt{4})^3 = 2^3 = \boxed{8}$

5. $32^{\frac{-3}{5}}$ $(\sqrt[5]{32})^{-3} = 2^{-3} = \boxed{\frac{1}{8}}$

6. $9^{\frac{-3}{2}}$ $(\sqrt{9})^{-3} = 3^{-3} = \boxed{\frac{1}{27}}$

Simplify the following:

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

8. $(x^3)^{\frac{1}{3}}$ $= \boxed{x}$

9. $(x^6)^{\frac{1}{3}}$ $x^{6/3} = \boxed{x^2}$

10. $(xy)^{\frac{2}{3}}$

$\boxed{x^{2/3}y^{2/3}}$

11. $(4x^4y^2)^{\frac{1}{2}}$

$\boxed{2x^2y}$

12. $(64x^3y^{12})^{\frac{1}{3}}$

$\boxed{4xy^4}$

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Rewrite the expression using rational exponents:

1) $\sqrt[3]{9}$ $9^{1/3}$

2) $\sqrt[4]{29}$ $29^{1/4}$

3) $\sqrt[7]{3}$ $3^{1/7}$

Rewrite the expression using radical notation:

4) $4^{\frac{1}{3}}$ $\sqrt[3]{4}$

5) $5^{\frac{1}{7}}$ $\sqrt[7]{5}$

6) $6^{\frac{1}{4}}$ $\sqrt[4]{6}$

Use radical notation to write the indicated roots:

7) Fifth root(s) of 14
$\sqrt[5]{14}$

8) Ninth root(s) of 216
$\sqrt[9]{216}$

9) Tenth root(s) of 110
$\sqrt[10]{110}$

Evaluate the expression without using a calculator: MUST SHOW ALL YOUR WORK!!!!!!!!!!

10) $125^{\frac{2}{3}}$ $(\sqrt[3]{125})^2 = 5^2$
$\boxed{25}$

11) $4^{\frac{7}{2}}$
$(\sqrt{4})^7 = 2^7 = \boxed{128}$

12) $81^{\frac{3}{4}}$ $(\sqrt[4]{81})^3 = \boxed{27}$

13) $-8^{\frac{5}{3}}$
$(\sqrt[3]{-8})^5 = -2^5 = \boxed{-32}$

14) $9^{\frac{3}{2}}$
$(\sqrt{9})^3 = 3^3 = \boxed{27}$

15) $25^{\frac{3}{2}}$ $(\sqrt{25})^3 = 5^3 = \boxed{125}$

Simplify the expression

16). $(a^2b^2)^{\frac{1}{2}}$

$\boxed{ab}$

17). $(x^3y^3)^{\frac{1}{3}}$

$\boxed{xy}$

18). $(8x^9y^{12})^{\frac{1}{3}}$

$\boxed{2x^3y^4}$

19) $(8x^3y^3)^{\frac{2}{3}}$

$(\sqrt[3]{8})^2 x^{6/3} y^{6/3}$

$2^2 x^2 y^2$

$\boxed{4x^2y^2}$

20) $(16x^{10}y^{12})^{\frac{1}{2}}$

$\boxed{4x^5y^6}$

21) $(27x^6y^{15})^{\frac{1}{3}}$

$\boxed{3x^2y^5}$

22) $(9x^6y^8)^{\frac{3}{2}}$

$3^3 x^{18/2} y^{24/2}$

$\boxed{27x^9y^{12}}$

23) $(7x^8y^2z)^{\frac{2}{3}}$

$\boxed{7^{2/3} x^{16/3} y^{4/3} z^{2/3}}$

24) $(3x^2y^8)^{\frac{5}{2}}$

$3^{5/2} x^{10/2} y^{\frac{40}{2}}$

$\boxed{3^{5/2} x^5 y^{20}}$