## Unit 3 Lesson 5: Negative Rational Exponents

### 1 Math Talk: Don’t Be Negative (Warm up)

#### Student Task Statement

Evaluate mentally.

$9^{2}$

$9^{-2}$

$9^{\frac{1}{2}}$

$9^{-\frac{1}{2}}$

### 2 Negative Fractional Powers Are Just Numbers

#### Student Task Statement

1. Complete the table as much as you can without using a calculator. (You should be able to fill in three spaces.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| * $x$
 | * -2
 | * $-\frac{5}{3}$
 | * $-\frac{4}{3}$
 | * -1
 | * $-\frac{2}{3}$
 | * $-\frac{1}{3}$
 | * 0
 |
| * $2^{x}$ (using exponents)
 | * $2^{-2}$
 | * $2^{-\frac{5}{3}}$
 | * $2^{-\frac{4}{3}}$
 | * $2^{-1}$
 | * $2^{-\frac{2}{3}}$
 | * $2^{-\frac{1}{3}}$
 | * $2^{0}$
 |
| * $2^{x}$ (decimal approximation)
 |  |  |  |  |  |  |  |

* 1. Plot these powers of 2 in the coordinate plane. ​​​​​​
	2. Connect the points as smoothly as you can.
	3. Use your graph of $y=2^{x}$ to estimate the value of the other powers in the table, and write your estimates in the table.
* 
1. Let’s investigate $2^{-\frac{1}{3}}$.
	1. Write $2^{-\frac{1}{3}}$ using radical notation.
	2. What is the value of $\left(2^{-\frac{1}{3}}\right)^{3}$?
	3. Raise your estimate of $2^{-\frac{1}{3}}$ to the third power. What should it be? How close did you get?
2. Let’s investigate $2^{-\frac{2}{3}}$.
	1. Write $2^{-\frac{2}{3}}$ using radical notation.
	2. What is $\left(2^{-\frac{2}{3}}\right)^{3}$?
	3. Raise your estimate of $2^{-\frac{2}{3}}$ to the third power. What should it be? How close did you get?

### 3 Any Fraction Can Be an Exponent

#### Student Task Statement

1. For each set of 3 numbers, cross out the expression that is not equal to the other two expressions.
	1. $8^{\frac{4}{5}}$, $\sqrt[4]{8}^{5}$, $\sqrt[5]{8}^{4}$
	2. $8^{-\frac{4}{5}}$, $\frac{1}{\sqrt[5]{8^{4}}}$, $-\frac{1}{\sqrt[5]{8^{4}}}$
	3. $\sqrt{4^{3}}$, $4^{\frac{3}{2}}$, $4^{\frac{2}{3}}$
	4. $\frac{1}{\sqrt{4^{3}}}$, $-4^{\frac{3}{2}}$, $4^{-\frac{3}{2}}$
2. For each expression, write an equivalent expression using radicals.
	1. $17^{\frac{3}{2}}$
	2. $31^{-\frac{3}{2}}$
3. For each expression, write an equivalent expression using only exponents.
	1. $\left(\sqrt{3}\right)^{4}$
	2. $\frac{1}{\left(\sqrt[3]{5}\right)^{6}}$

### 4 Make These Exponents Less Complicated (Optional)

#### Student Task Statement

Match expressions into groups according to whether they are equal. Be prepared to explain your reasoning.

$\left(\sqrt{3}\right)^{4}$

$\sqrt{3^{2}}$

$\left(3^{\frac{1}{2}}\right)^{4}$

$\left(\sqrt{3}\right)^{2}⋅\left(\sqrt{3}\right)^{2}$

$\left(3^{2}\right)^{\frac{1}{2}}$

$3^{2}$

$3^{\frac{4}{2}}$

$\left(3^{\frac{1}{2}}\right)^{2}$



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