# 6.3: Rational Exponents: $a^{\frac{m}{n}}$

**Warm Up:**

Simplify the following:

#15. $\frac{1}{2x^{-5}}$ =

#26. $\frac{8}{m^{-2}}$ =

#28. $\left(\frac{3}{x^2}\right)^{-2}$ =

#6. $8^3 * 0^{-2} =$

#8. $(-3^{-2})^{-1} =$

#23. $(-10a)^0$ =

When you have a fraction as an exponent, a rational number, we call that a rational exponent. They are usually in the form:

$$a^{\frac{m}{n}}$$

Common rational exponents:

$a^{\frac{1}{2}} =$ ______ →

$a^{\frac{1}{3}} =$ ______ →

$a^{\frac{1}{4}} =$ ______ →

Sometimes the numerator of the fraction is not 1. It is often helpful to split fractions into the following forms:

$$a^{\frac{m}{n}} = \left(a^{\frac{1}{n}}\right)^m \quad or \quad a^{\frac{m}{n}} = (a^m)^{\frac{1}{n}}$$

**Example 1:** Simplify by splitting up the fraction in the exponent.

a) $64^{\frac{2}{3}}$

b) $8^{\frac{4}{3}}$

Going back and forth from radical to exponential form can be quite useful sometimes. Here are some examples.

**Example 2:** Write in exponential form

a) $\sqrt{14}$ =

b) $\sqrt[3]{5}$ =

c) $\sqrt[4]{9}$ =

d) $\left(\sqrt{5}\right)^3$ =

e) $\sqrt[5]{(-6)^3}$ =

**Example 3:** Write in radical form

a) $12^{\frac{1}{2}}$ =

b) $-9^{\frac{1}{4}}$ =

c) $7^{\frac{3}{2}}$ =

d) $19^{\frac{5}{7}}$ =

Using these skills, we can make questions more efficient if we simplify the exponents first. Especially when dealing with variables.

**Example 4:** Simplify

a) $\sqrt{16x^{16}}$ =

b) $\sqrt{4x^4y^2}$ =

c) $12^{\frac{2}{3}}$ =

d) $\sqrt[5]{6^5}$ =