Warm Up:
Simplify the following expressions:

a) $(4x^3)(3x^4)$ b) $(27x^4) \div (3x^2)$ c) $(5x^4y^3)^2$

$$= (4)(3)(x^{3+4}) \qquad = \left(\frac{27}{3}\right)(x^{4-2}) \qquad = (5^2)(x^{4(2)})$$

$$= 12x^7 \qquad\qquad = 9x^2 \qquad\qquad (y^{3(2)})$$

$$= 25x^8y^6$$

Fractional Exponents

Lesson objectives

- I understand what the numerator and denominator mean in an exponent
- I can rewrite a rational exponent in radical notation
- I can rewrite radical notation as a rational exponent

1.1

| Lesson objectives | Teachers' notes | Lesson notes |

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Rational Exponents

Using the exponent laws simplify the following:

$$4^{\frac{1}{2}} \times 4^{\frac{1}{2}} \qquad \text{and} \qquad 27^{\frac{1}{3}} \times 27^{\frac{1}{3}} \times 27^{\frac{1}{3}}$$

$$= 4^{\frac{1}{2}+\frac{1}{2}} = 4^1 = 4 \qquad = 27^{\frac{1}{3}+\frac{1}{3}+\frac{1}{3}} = 27^1 = 27$$

What value would you assign to $4^{\frac{1}{2}}$　　$27^{\frac{1}{3}}$　?

$$4^{\frac{1}{2}} = 2 \qquad\qquad 27^{\frac{1}{3}} = 3$$

What about $16^{\frac{1}{2}}$　　　$8^{\frac{1}{3}}$　　　$64^{\frac{1}{4}}$　?

$$16^{\frac{1}{2}} = 4 \qquad 8^{\frac{1}{3}} = 2 \qquad 64^{\frac{1}{4}} = 2.828$$

Rational Exponents

Essentially, this has given us a new way to write radicals.

The radical is incorporated into the exponent as the **denominator of the fraction**.

Square root ⟶ Exponent = 1/2

Cubed root ⟶ Exponent = 1/3

Fourth root ⟶ Exponent = 1/4

Rational Exponents

The numerator of the exponent still represents the power.

For example: $\qquad 8^{\frac{2}{3}}$

$$\left(8^{1/3}\right)^2 \quad \text{or} \quad \left(\sqrt[3]{8}\right)^2$$

Things we should know....

$8^{\frac{1}{3}} = 2$ $\qquad\qquad$ $16^{\frac{1}{4}} = 2$ $\qquad$ All the perfect squares!!

$27^{\frac{1}{3}} = 3$ $\qquad\qquad$ $81^{\frac{1}{4}} = 3$ $\qquad\qquad$ 1^2

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ 2^2

$64^{\frac{1}{3}} = 4$ $\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ 3^2

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ $\vdots$

$125^{\frac{1}{3}} = 5$ $\qquad\qquad$ $625^{\frac{1}{4}} = 5$ $\qquad$ 98^2

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ 99^2

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ 100^2

Example

Evaluate

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

$$= \left(\sqrt[3]{64}\right)^2$$

$$= (4)^2$$

$$= 16$$

b) $16^{\frac{2}{3}}$

$$= \left(\sqrt[3]{16}\right)^2$$

$$= (2.5198)^2$$

$$= 6.3496$$

c) $(-27)^{\frac{4}{3}}$

$$= \left(\sqrt[3]{-27}\right)^4$$

$$= (-3)^4$$

$$= 81$$