1.4 Powers with Positive Rational Exponents

Remember

1. $3^6 \times 3^5 \overset{+}{=} 3^{11}$
2. $4^7 \div 4^2 \overset{-}{=} 4^5$
3. $(5^2)^6 \overset{\times}{=} 5^{12}$

single power

4. $\left(\frac{2}{3}\right)^2 = \frac{2^2}{3^2} = \frac{4}{9}$

no brackets

5. $4^{-3} = \frac{1}{4^3}$

no negative exponent

True also for fraction exponents

$$8^{\frac{4}{7}} \cdot 8^{\frac{2}{7}} = 8^{\frac{6}{7}}$$

$$9^{\frac{4}{3}} \div 9^{\frac{2}{3}} = 9^{\frac{2}{3}}$$

If the exponent is a fraction, the denominator portion represents the root.

ex. $36^{\frac{1}{2}} = \sqrt{36} = 6$

$$8^{\frac{1}{3}} = \sqrt[3]{8} = 2$$

$$\left(\frac{4}{9}\right)^{\frac{1}{2}} = \sqrt{\frac{4}{9}} = \frac{\sqrt{4}}{\sqrt{9}} = \frac{2}{3}$$

$$\left(\frac{4}{9}\right)^{\frac{1}{2}} = \sqrt{\frac{4}{9}} = \frac{\sqrt{4}}{\sqrt{9}} = \frac{2}{3}$$

Then, $8^{\frac{2}{3}}$ can be $\left(\sqrt[3]{8}\right)^2$ OR $\sqrt[3]{8^2}$

$= 2^2 \qquad\qquad = \sqrt[3]{64}$

$= 4 \qquad\qquad = 4$

So, $$\boxed{x^{\frac{m}{n}} \longrightarrow \left(x^{\frac{1}{n}}\right)^m \text{ OR } \left(x^m\right)^{\frac{1}{n}} \\ \left(\sqrt[n]{x}\right)^m \qquad \sqrt[n]{x^m}}$$

ex.1. $27^{\frac{4}{3}} = \sqrt[3]{27^4}$ OR $\left(\sqrt[3]{27}\right)^4$

$= 3^4 = 81$

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

$= (-3)^4 = 81$

3. $32^{\frac{2}{5}} = \left(\sqrt[5]{32}\right)^2$ OR $\sqrt[5]{32^2}$

$=$

3. $32 = \left(\sqrt[5]{32}\right)$ OR $\sqrt[5]{32}$

$= 2^2 = 4$

4. $32^{0.4}$

decimals $\Rightarrow$ change to <u>fraction</u>

$0.4 = \frac{4}{10} = \frac{2}{5}$

$32^{\frac{2}{5}}$

same as #3

$= 4$

5. $\left(\frac{4}{25}\right)^{\frac{3}{2}} = \left(\sqrt{\frac{4}{25}}\right)^3 = \left(\frac{2}{5}\right)^3 = \frac{8}{125}$

6. $0.36^{1.5}$

decimals $\rightarrow$ change <u>ALL</u> to fractions

$0.36 = \frac{36}{100} = \frac{9}{25}$

$1.5 = 1\frac{1}{2} = \frac{3}{2}$

$= \left(\frac{9}{25}\right)^{\frac{3}{2}}$

$= \left(\sqrt{\frac{9}{25}}\right)^3 = \left(\frac{3}{5}\right)^3 = \frac{27}{125}$

p41 # (3-12, 14) $\rightarrow$ min 5 from each

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