4.2 Rational Exponents

Study 4.2 # 1 - 71

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Jan 23-12:50 PM

4.2 Rational Exponents

$$(3^2)^3 = (3 \cdot 3)(3 \cdot 3)(3 \cdot 3) = 3^6$$

3 factors of 3^2

$$(a^m)^n = a^{mn}$$

$(3\square)^3 = 3^6$ $\qquad$ $(3\square)^2 = 3^6$

$(3\square)^2 = 3^2$ $\qquad$ $(3\square)^2 = 3^1$

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4.2 Rational Exponents

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4.2 Rational Exponents

$$(a^m)^n = a^{mn}$$

$$(3^{\square})^2 = 3^1$$

Need to define $3^{1/2}$

Need to define $3^{1/n}$

$b^{1/n}$

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4.2 Rational Exponents

$$b^{1/n},\ n = 2, 3, 4, 5,...$$

	n even	n odd
$b \geq 0$	Principal n^{th} root of b $\sqrt[n]{b}$	n^{th} root of b $\sqrt[n]{b}$
$b < 0$	not a real #	n^{th} root of b $\sqrt[n]{b}$

4.2 Rational Exponents

$b^{1/n}$, n = 2, 3, 4, 5,...

	n even	n odd
b ≥ 0	Principal $4^{\frac{1}{2}}=2$ nth root of b $+\sqrt[n]{b}$ $8^{\frac{1}{2}}$	nth root of b $\sqrt[n]{b}$ $8^{1/3}$
b < 0	not a real # $\emptyset$ $\sqrt{-4}$ DNE $(-4)^{1/2}$	nth root of b $\sqrt[n]{b}$ $(-8)^{1/3}=-2$

$b^{\frac{1}{n}}=x$

$b=x^n$

$4^{\frac{1}{2}}=x$

$x^2=4$

solve for x:

$x^2=4$

$x=\pm 2$

for n even, get + and -

But, for $b^{1/n}$ get only the positive root, the principal root.

4.2 Rational Exponents

$b^{1/n}$, n = 2, 3, 4, 5,...

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m, n rational numbers

$$b^m b^n = b^{m+n}$$

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

$$(ab)^m = a^m b^m$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$(a^m)^n = a^{mn}$$

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4.2 Rational Exponents

problems 2, 12, 22,...

$27^{1/3} = (3^3)^{1/3} = 3^1 = 3$

$(a^m)^n = a^{mn}$

$9^{-3/2} = \frac{1}{9^{3/2}} = \frac{1}{(3^2)^{3/2}}$

$= \frac{1}{3^3} = \frac{1}{27}$

$(3^2)^{3/2} = 3^{2 \cdot \frac{3}{2}} = 3^3$

$25^{-3/2} = \frac{1}{25^{3/2}} = \frac{1}{(5^2)^{3/2}} = \frac{1}{5^3} = \frac{1}{125}$

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4.2 Rational Exponents

32. $G: f(x) = 81^x$ $F: f\left(\frac{1}{4}\right)$ exponential function. Variable in exponent

$f(\ ) = 81^{(\ )}$

$f\left(\frac{1}{4}\right) = 81^{\frac{1}{4}}$

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

$= 3^1 = 3$

$81 = 9 \cdot 9$

$= 3 \cdot 3 \cdot 3 \cdot 3$

$= 3^4$

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Mar 27-1:24 PM

4.2 Rational Exponents

$b^{1/5} b^{3/5} = b^{\frac{1}{5}+\frac{3}{5}} = b^{\frac{4}{5}}$

$b^m b^n = b^{m+n}$

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Mar 27-4:05 PM

4.2 Rational Exponents

$$(6bc^2)^{5/7}(6bc^2)^{2/7} = (6bc^2)^{7/7} = 6bc^2$$

$$\frac{b^{-2/3}}{b^{1/7}} = b^{-2/3-1/7}$$

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

$$= b^{\frac{-17}{21}}$$

$$= \frac{1}{b^{\frac{17}{21}}}$$

$$-\frac{2}{3} - \frac{1}{7}$$

$$-\frac{14}{21} - \frac{3}{21} = \frac{-17}{21}$$

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4.2 Rational Exponents

$27^{\frac{4}{3}}$

$(3^3)^{\frac{4}{3}} = 3^4$

$= 81$

$(2^{\frac{2}{3}} 5^{\frac{1}{3}})^3$

$(2^{\frac{2}{3}})^3 \cdot (5^{\frac{1}{3}})^3$

$2^2 \cdot 5 = 20$

$(a^m)^n = a^{mn}$

$(ab)^m = a^m b^m$

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4.2 Rational Exponents

$$\frac{b^{3/4}\,c^{1/2}}{b^{-1/4}\,c^{-1/2}}$$

$$= b^{3/4} c^{1/2} b^{1/4} c^{1/2}$$

$$= b^{\frac{4}{4}} c^{\frac{2}{2}}$$

$$= bc$$

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

$$= b^{\frac{3}{4}-(-\frac{1}{4})}\, c^{\frac{1}{2}-(-\frac{1}{2})}$$

$$= b^{\frac{4}{4}} c^{\frac{2}{2}}$$

$$= bc$$

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4.2 Rational Exponents

$$\left(\frac{27b^{1/3}c^{3/4}}{8b^{-2/3}c^{1/2}}\right)^{4/3}$$

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

$$\left[\frac{27}{8}b^{\frac{1}{3}+\frac{2}{3}}c^{\frac{3}{4}-\frac{1}{2}}\right]^{4/3}$$

$$\left(\frac{27}{8}bc^{1/4}\right)^{4/3}$$

$$\frac{27^{4/3}}{8^{4/3}}b^{4/3}c^{1/4\cdot 4/3} = \frac{81}{16}b^{4/3}c^{1/3}$$

OR eliminate neg exp first

$$\left[\frac{27b^{1/3}b^{2/3}c^{3/4}}{8c^{1/2}}\right]^{4/3}$$

$$\left(\frac{27bc^{3/4}}{8c^{1/2}}\right)^{4/3}$$

$$\left(\frac{27}{8}bc^{1/4}\right)^{4/3}$$

$$27^{4/3} = (3^3)^{4/3} = 3^4 = 81 \qquad \tfrac{3}{4}-\tfrac{1}{2}=\tfrac{3}{4}-\tfrac{2}{4}=\tfrac{1}{4}$$

$$8^{4/3} = (2^3)^{4/3} = 2^4 = 16$$

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