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Example 2 - Multiplying or Dividing Powers with the Same Base

$a)\ \left(6^{\frac{1}{4}}\right)\left(6^{\frac{7}{4}}\right)$ $b)\ (n)^{3}\left(n^{-\frac{1}{5}}\right)$ $c)\ d^{\frac{3}{2}} \div d^{\frac{1}{2}}$ $d)\ \dfrac{3^{-\frac{2}{3}}}{3^{-\frac{4}{3}}}$

a)

$6^{\frac{1}{4}+\frac{7}{4}}$

$6^{\frac{8}{4}}$

6^{2}

b)

$n^{3+-\frac{1}{5}}$

$n^{\frac{3(5)}{1(5)}-\frac{1}{5}}$

$n^{\frac{15}{5}-\frac{1}{5}}$

$n^{\frac{14}{5}}$

c)

$d^{\frac{3}{2}-\frac{1}{2}}$

$d^{\frac{2}{2}} = d^{1}$

$= d$

d)

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

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

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

$\sqrt[3]{3^{2}}$

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Example 2 - Multiplying or Dividing Powers with the Same Base

a) $\left(6^{\frac{1}{4}}\right)\left(6^{\frac{7}{4}}\right)$ b) $(n)^3\left(n^{\frac{1}{5}}\right)$ c) $d^{\frac{3}{2}} \div d^{\frac{1}{2}}$ d) $\dfrac{3^{-\frac{2}{3}}}{3^{-\frac{4}{3}}}$

a) $6^{\left(\frac{1}{4}+\frac{7}{4}\right)}$

$6^{\frac{8}{4}}$

6^2 or 36

b) $n^{\left(3+\frac{-1}{5}\right)}$

$n^{\left(\frac{15}{5}-\frac{1}{5}\right)}$

$n^{\frac{14}{5}}$

c) $d^{\frac{3}{2}-\frac{1}{2}}$

$d^{\frac{2}{2}}$

d^1 or d

d) $3^{-\frac{2}{3}-\frac{-4}{3}}$

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

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

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Multiplying or Dividing Powers with Different Bases

a) $\dfrac{9^3}{81^2}$ b) $\dfrac{2^{1.8}}{4^{0.3}}$ c) $\dfrac{25^{1.2}}{125^{0.4}}$

a) $\dfrac{(3^2)^3}{(3^4)^2} = \dfrac{3^6}{3^8}$

$= 3^{6-8}$

$= 3^{-2}$

$\dfrac{1}{3^2}$

$3^2 = 9$

$3^4 = 81$

b) $\dfrac{2^{1.8}}{(2^2)^{0.3}}$

$\dfrac{2^{1.8}}{2^{0.6}}$

$2^{1.8-0.6}$

$2^{1.2}$

c) $\dfrac{(5^2)^{1.2}}{(5^3)^{0.4}}$

$\dfrac{5^{2.4}}{5^{1.2}}$

$5^{2.4-1.2}$

$5^{1.2}$

$25 = 5^2$

$125 = 5^3$

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Multiplying or Dividing Powers with Different Bases

$a)\ \frac{9^3}{81^2}$ $b)\ \frac{2^{1.8}}{4^{0.3}}$ $c)\ \frac{25^{1.2}}{125^{0.4}}$

In order to solve these questions, you will need to convert the questions so that they have the same base

$a)\ \frac{9^3}{(9^2)^2}$ $b)\ \frac{2^{1.8}}{(2^2)^{0.3}}$ $c)\ \frac{(5^2)^{1.2}}{(5^3)^{0.4}}$

$\frac{9^3}{9^4}$ $\frac{2^{1.8}}{2^{0.6}}$ $\frac{5^{2.4}}{5^{1.2}}$

9^{3-4} $2^{1.8-0.6}$ $5^{1.2} \doteq 6.899$

9^{-1} or $\frac{1}{9}$ $2^{1.2} \doteq 2.297$

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Example 3 - Simplifying Powers with Rational Exponents

$a)\ (8x^9)^{\frac{2}{3}}$ $b)\ \left(m^5 m^{\frac{1}{2}}\right)^{\frac{2}{3}}$ $c)\ \left(\frac{3^4}{16}\right)^{-0.75}$

$8^{2/3} x^{\frac{9}{1}\cdot\frac{2}{3}}$

$8^{2/3} x^{\frac{18}{3}}$

$8^{2/3} x^6$

$\sqrt[3]{8^2}\, x^6$

$2^2 x^6$

$4x^6$

$\left(m^{\frac{5(2)}{1(2)}+\frac{1}{2}}\right)^{2/3}$

$\left(m^{\frac{10}{2}+\frac{1}{2}}\right)^{2/3}$

$\left(m^{\frac{11}{2}}\right)^{2/3}$

$m^{\frac{11}{2}\cdot\frac{2}{3}}$

$m^{\frac{22}{6}}$

$m^{\frac{11}{3}}$

$\left(\frac{16}{3^4}\right)^{0.75}$

$\frac{16^{0.75}}{3^{4\cdot 0.75}}$

$\frac{16^{0.75}}{3^3}$

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Example 3 - Simplifying Powers with Rational Exponents

$a)\ \left(8x^{9}\right)^{\frac{2}{3}}$

Distribute the exponent to *both* the coefficient and the variable in the brackets

$$\left(8^{\frac{2}{3}}\right)\left(x^{9}\right)^{\frac{2}{3}}$$

Evaluate both parts of the question separately

$$(4)\left(x^{\frac{18}{6}}\right) \quad \text{or} \quad 4x^{3}$$

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Example 3 - Simplifying Powers with Rational Exponents

$b)\ \left(m^{5}m^{\frac{1}{2}}\right)^{\frac{2}{3}}$

This question can be solved in two different ways:

Method One

Because the bases are the same, you can add the exponents within the brackets

$$\left[m^{5+\frac{1}{2}}\right]^{\frac{2}{3}}$$

$$\left[m^{\frac{11}{2}}\right]^{\frac{2}{3}}$$

Use *Power of a Power* rule

$$m^{\frac{22}{6}} \quad or \quad m^{\frac{11}{3}}$$

Method Two

Use the *Power of a Power* rule

$$\left(m^{\frac{10}{3}}\right)\left(m^{\frac{2}{6}}\right)$$

Add the exponents

$$m^{\frac{22}{6}} \quad or \quad m^{\frac{11}{3}}$$

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Example 3 - Simplifying Powers with Rational Exponents

$c)\ \left(\frac{3^4}{16}\right)^{-0.75}$

Convert the base to a single fraction with the same exponent

$$\left(\frac{3^4}{2^4}\right)^{-0.75}$$

$$\left[\left(\frac{3}{2}\right)^4\right]^{-0.75}$$

Use the *Power or a Power* rule and solve

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

$$\left(\frac{2}{3}\right)^3 = \frac{8}{27}$$

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Example 4 - Applying Powers with Rational Exponents

The price of a vintage video game with the box and instructions doubles every 20 years. The video game initially cost \$60.00. The present value of the game came can be modelled using the formula

$$N = 60(2)^{\frac{20}{20}}$$

N= present value

t = years.

where N is the present value in t years.

a) What does that value 2 in the formula mean?
b) What is the value of the video game after 20 years? 120
c) What is the value of the video game after 4 years? \$68.92
d) What is the value of the video game after 33 years?

$N = 60(2)^{33/20}$ $N = 60(2)^{4/20}$

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Solution:

a) The 2 indicates that the value of the video game doubles every 20 years

b) The video game will have doubled in value after 20 years; as result, the video game will be worth $120.00 (no work is necessary to solve this question).

c) After 4 years you can substitute into the equation like so:

$$N = 60(2)^{\frac{4}{20}}$$

$$N = 60(2)^{0.2}$$

$$N = 60(1.148698...)$$

$$N = 68.92$$

d) After 33 years you can substitute into the equation like so:

$$N = 60(2)^{\frac{33}{20}}$$

$$N = 60(2)^{1.65}$$

$$N = 60(3.138336...)$$

$$N = 188.30$$

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End of Lesson

Assignment: Page 180 # 1-5, 7, 8, 10, 12, 14, 15

Challenge: Page 180 # 16, 17

$2\sqrt{3}$, $3\sqrt{2}$, $\sqrt{45}$

$\sqrt{3(2)^2}$ $\sqrt{2(3)^2}$

$\sqrt{3(4)}$ $\sqrt{2(9)}$

$\sqrt{12}$ $\sqrt{18}$

$2\sqrt{3}$, $3\sqrt{2}$, $\sqrt{45}$

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