M9 - 3.0 - Exponents Notes

$2^3 \times 2^2 = 2^{3+2} = 2^5$ Add Exponents

$\frac{3^5}{3^2} = 3^{5-2} = 3^3$ Subtract Exponents

$(2^2)^3 = 2^{2\times 3} = 2^6$ Multiply Exponents

$(3 \times 4)^2 =$
$(3^1 \times 4^1)^2$ OR $(3 \times 4)^2 =$ 12^2 Give it an Exponent of 1
$3^2 \times 4^2$

$\frac{12^3}{3^3} = \left(\frac{12}{3}\right)^3$ OR $\frac{12^3}{3^3} = \frac{(3^1 \times 4^1)^3}{3^3}$ $\left(\frac{3}{5}\right)^2 = \left(\frac{3^1}{5^1}\right)^2$
$(4)^3$ $\frac{3^3 \times 4^3}{3^3}$ $\frac{3^2}{5^2} = \frac{9}{25}$
4^3 4^3

$(2x)^3 =$
$(2^1 x^1)^3$
$2^3 x^3$
$8x^3$

Pick an x *value**
Sub into $x^* = 3$
question/answer
Must be equal!

$(2x)^3$	$8x^3$
$(2(3))^3$	$8(3)^3$
6^3	8×27
216	216

$-2^2 = -2^2 = -2 \times 2 = -4$ $-(-2^2) = 4$ $-(2)^2 = -4$

$(-2)^3 = (-2) \times (-2) \times (-2) = -8$ $-(-2)^3 = 8$ $(-2^2) = -4$

$(-2)^4 = (-2) \times (-2) \times (-2) \times (-2) = 16$ $-(-2)^4 = -16$

Step 1 ——— ←——Over

$5^{-2} = \frac{1}{5^2}$ $\frac{1}{3^{-2}} = \frac{3^2}{1}$ $3a^{-2} = \frac{3}{a^2}$ $3^{-3}a^{-2} = \frac{1}{3^3 a^2} = \frac{1}{27a^2}$ $(2x)^{-3} = \frac{1}{(2x)^3} = \frac{1}{2^3 x^3} = \frac{1}{8x^3}$

$\frac{2}{(3x)^{-2}} =$
$\frac{2(3x)^2}{1}$
$2(3^2 x^2)$
$2(9x^2)$
$18x^2$

$\left(\frac{5^1}{3^1}\right)^{-2} = \frac{5^{-2}}{3^{-2}} = \frac{3^2}{5^2}$
OR
$\left(\frac{5}{3}\right)^{-2} = \left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2}$

$\frac{2x^5 y^{-2}}{z^{-3}} = \frac{2x^5 z^3}{y^2}$ $\frac{5^2}{5^5} = 5^{2-5} = 5^{-3} = \frac{1}{5^3}$

$\frac{5^2}{5^{-3}} = 5^2\, 5^3 = 5^{2+3} = 5^5$
OR
$\frac{5^2}{5^{-3}} = 5^{2-(-3)} = 5^5$

$\frac{5^{-2}}{5^3} = \frac{1}{5^3 5^2} = \frac{1}{5^{3+2}} = \frac{1}{5^5}$
OR
$\frac{5^{-2}}{5^3} = \frac{1}{5^{3-(-2)}} = \frac{1}{5^5}$

$16 = 4^2$ 16 OR $16 = 2^4$ 16
4 4 4 4
Change of Base 2 2 2 2

4^3
$(4)^3$
$(2^2)^3$
2^6

$4^3 \times 8^2$
$(2^2)^3 \times (2^3)^2$
$2^6 \times 2^6$
2^{12}

6^3
$(3 \times 2)^3$
$(3^1 \times 2^1)^3$
$3^3 \times 2^3$

64^3 64^3 64^3
$(8^2)^3$ $(4^3)^3$ $(2^6)^3$
8^6 4^9 2^{18}

$\frac{2^3 \times 2^4}{2^5} =$
$\frac{2^{3+4}}{2^5}$
$\frac{2^7}{2^5}$
2^{7-5}
$2^2 = 4$

$\frac{3^4 \times 3^{-3}}{9} =$
$\frac{3^1}{3^2}$
3^{1-2}
$3^{-1} = \frac{1}{3^1}$

$\frac{4^2 \times 16^3}{128^2} =$
$\frac{((2^2)^2 \times (2^4)^3)}{(2^7)^2}$
$\frac{2^4 \times 2^{12}}{2^{14}}$
$\frac{2^{16}}{2^{14}}$
$2^{(16-14)} = 2^2 = 4$

$\frac{(2x^3y^2)(6xy^4)}{(4x^3y)} =$
$\frac{12x^4y^6}{4x^3y}$
$3xy^5$

$\frac{(8x^3y^2)^2(6xy^4)^{-2}}{(4x^3y)} =$
$\frac{(8x^3y^2)^2}{(4x^3y)(6xy^4)^2}$
$\frac{64x^6y^4}{(4x^3y)(36x^2y^8)}$
$\frac{64x^6y^4}{144x^5y^9} = \frac{4x}{9y^5}$

M10 - 4.0 - Exponent/Radical Notes

$x^3 \times x^2 = x^{3+2} = x^5$ Add Exponents $2^3 \times 2^2 = 32 = 2^5$ ✓

$\frac{x^5}{x^2} = x^{5-2} = x^3$ Subtract Exponents $(x^2)^3 = x^{2\times 3} = 2^6$ Multiply Exponents

$(x^1 \times y^1)^2 = x^2y^2$ $(2x)^3 = 2^3x^3 = 8x^3$ $\left(\frac{2^1x^1}{y^3}\right)^2 = \frac{2^2x^2}{y^{2\times 3}} = \frac{4x^2}{y^6}$ $\left(\frac{6mn^3}{4m^2n}\right)^3$ $\left(\frac{3n^2}{2m}\right)^3$ Simplify 1st $\frac{3^3n^6}{2^3m^3} = \frac{27n^6}{8m^3}$

$x^{-2} = \frac{1}{x^2}$ $\frac{1}{x^{-2}} = \frac{x^2}{1}$ $3a^{-2} = \frac{3}{a^2}$ $3^{-3}a^{-2} = \frac{1}{3^3a^2}$ $(2x)^{-3} = \frac{1}{(2x)^3} = \frac{1}{8x^3}$ $\frac{x^{-2}+5}{3} \neq \frac{5}{3x^2}$

$5^{\frac{3}{4}} = \sqrt[4]{5^3}$ $x^{\frac{2}{3}} = \sqrt[3]{x^2}$ $8^{\left(\frac{1}{3}\right)} = \sqrt[3]{8^1} = 2$

8 → 4, 2 → 2, 2

$8^{\frac{2}{3}} = \sqrt[3]{8^2} = 2^2 = 4$ $\frac{(-27)^{\frac{4}{3}}}{\sqrt[3]{(-27)^4}} = (-3)^4 = 81$ $\left(2^{\frac{1}{2}}\right)\left(2^{\frac{1}{4}}\right) = 2^{\frac{3}{4}} = \sqrt[4]{2^3} = \sqrt[4]{8}$

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

$5^{\frac{1}{2}}x^{\frac{3}{2}}$

$\sqrt[2]{5^1}\sqrt[2]{x^3}$

$\sqrt{5}x\sqrt{x}$

$x\sqrt{5x}$

$(3)^{\frac{3}{2}} \div (3)^{\frac{3}{5}} = (3)^{\frac{9}{10}} = \sqrt[10]{3^9}$

$\left(\sqrt[2]{2^3}\right)^{\frac{1}{4}} = \left(2^{\frac{3}{2}}\right)^{\frac{1}{4}} = 2^{\frac{3}{8}} = \sqrt[8]{2^3} = \sqrt[8]{8}$

$\frac{(-27x^9y^{-3})^{\frac{4}{3}}}{\sqrt[3]{(-27)^4x^{12}y^{-4}}} = \frac{81x^{12}}{y^4}$

$\left(\frac{-27a^3}{8}\right)^{\frac{1}{3}} = \frac{(-27)^{\frac{1}{3}}a^{3\times\frac{1}{3}}}{8^{\frac{1}{3}}} = \frac{-3a}{2}$

Simplify

12 → 4, 3; 4 → 2, 2

$\sqrt[2]{12} = \sqrt[2]{2\times 2\times 3} = 2\sqrt[2]{3}$ ✓ $\sqrt[2]{18} = \sqrt[2]{3\times 3\times 2} = 3\sqrt[2]{2}$ $\sqrt[2]{-9} =$ No Solution

$\sqrt[2]{54} = \sqrt[2]{3\times 3\times 3\times 2} = 3\sqrt[2]{3\times 2} = 3\sqrt[2]{6}$

$\sqrt[2]{72} = \sqrt[2]{3\times 3\times 2\times 2\times 2} = 3\times 2\sqrt[2]{2} = 6\sqrt[2]{2}$

$\frac{1}{4}\sqrt[2]{12} = \frac{1}{4}\sqrt[2]{2\times 2\times 3} = \frac{1}{4}\times 2\sqrt[2]{3} = \frac{1}{2}\sqrt[2]{3}$

$\sqrt[3]{24} = \sqrt[3]{2\times 2\times 2\times 3} = 2\sqrt[3]{3}$

$\sqrt[3]{54} = \sqrt[3]{3\times 3\times 3\times 2} = 3\sqrt[3]{2}$

$\sqrt[3]{-27} = \sqrt[3]{-3\times -3\times -3} = -3$

$\sqrt[5]{64} = \sqrt[5]{2\times 2\times 2\times 2\times 2\times 2} = 2\sqrt[5]{2}$

$\sqrt[2]{x^2} = \sqrt[2]{x\times x} = |x|$

$\sqrt[3]{24x^5} = \sqrt[3]{2\times 2\times 2\times 3\times x\times x\times x\times x\times x} = 2x\sqrt[3]{3x^2}$

Expand

$5\sqrt[2]{2} = \sqrt[2]{5\times 5\times 2} = \sqrt[2]{25\times 2} = \sqrt[2]{50}$

$5\sqrt[3]{2} = \sqrt[3]{5\times 5\times 5\times 2} = \sqrt[3]{125\times 2} = \sqrt[3]{250}$

$-\frac{1}{2}\sqrt[2]{3} = -\sqrt[2]{\frac{1}{2}\times\frac{1}{2}\times 3} = -\sqrt[2]{\frac{1}{4}\times 3} = -\sqrt[2]{\frac{3}{4}}$

$-4\sqrt[5]{5} = \sqrt[5]{-4\times 4\times 4\times 4\times 4\times 5} = \sqrt[5]{-4^5\times 5} = \sqrt[5]{-5120}$