Name: Key

A2 Review—Rules of Exponents

Rule #1—when multiplying the same base, add the exponents

Ex: $x^3 \cdot x^4 = x^7$ Ex: $-3x^4y \cdot 2x^2y^3 = -6x^6y^4$

Rule #2—when dividing the same base, subtract the exponents

Ex: $x^5 \div x^3 = x^2$ Ex: $\frac{10xy^4}{12x^3y^3} = \frac{5y}{6x^2}$

Rule #3—when raising a power to a power, multiply the exponents

Ex: $(3xy^3)^2 = 9x^2y^6$

Rule #4—Negative exponents essentially mean that instead of multiplying by the base that many times, you are dividing by the base that many times. So…move the base to the opposite side of the fraction but keep the absolute value of the exponent.

Ex: $5x^{-2}y^3 = \frac{5y^3}{x^2}$ Ex: $\frac{-4x^{-3}y^2}{8x^2y^{-4}} = -\frac{y^6}{2x^5}$

Rule #5—Any nonzero value raised to the zero power is 1

Ex: $(8x^3y)^0 = 1$ Ex: $5x^3y^0 = 5x^3$ Ex: $-x^0 = -1$

Product of Powers: Simplify the following

1. $3x^6y \cdot xy^4$

$3x^7y^5$

2. $(-4a^5bc^7)(-a^4c^3)$

$4a^9bc^{10}$

3. $(2xy)(-3x^2y^5)(-5x^6y)$

$30x^9y^7$

Power to a Power: Simplify the following

4. $\left(2r^3s\right)^3 = 2^3r^9s^3$ $= 8r^9s^3$

5. $\left(4x^3y^2\right)^2 = 4^2x^6y^4$ $= 16x^6y^4$

6. $-\left(xy^4z^3\right)^7 = -x^7y^{28}z^{21}$

Using Product of Powers & Power to a Power: Simplify the following

7. $\left(4x^3y^2\right)^2\left(-2x^2y\right)$

$16x^6y^4 \cdot -2x^2y$

$= -32x^8y^5$

8. $\left(-1xy^4z^3\right)^7\left(2x^2\right)^3\left(4yz^5\right)^2$

$-x^7y^{28}z^{21} \cdot 8x^6 \cdot 16y^2z^{10}$

$= -128x^{13}y^{30}z^{31}$

Dividing Monomials: Simplify the following (No negative exponents in simplified answers)

9. $\dfrac{3d^4e^7}{d^6e^3} = \dfrac{3e^4}{d^2}$

10. $\dfrac{\left(a^4bc^2\right)\left(3a^4b^3c^2\right)^2}{\left(3a^3b^3c^2\right)^3} = \dfrac{a^4bc^2 \cdot 9a^8b^6c^4}{27a^9b^9c^6}$

$= \dfrac{9a^{12}b^7c^6}{27a^9b^9c^6} = \dfrac{a^3}{3b^2}$

Negative and Zero Exponents: Simplify the following (No negative exponents in simplified answers)

11. $-6x^{-4}y^5 = \dfrac{-6y^5}{x^4}$

12. $\left(-3x^{-2}y^4\right)^3 = \dfrac{-27y^{12}}{x^6}$

13. $\cancel{\left(4^3\right)^0}^{\,1} \cdot \left(\dfrac{2}{3}\right)^{-3} = \dfrac{27}{8}$

14. $\cancel{\left(2ab^4\right)^0}^{\,1}\left(-2a^2b^5\right)^3 = -8a^6b^{15}$

One more exponent rule you might have forgotten. Exponents can be rational (fraction or decimal).

$x^{\frac{a}{b}} = \left(\sqrt[b]{x}\right)^a = \sqrt[b]{x^a}$

The following examples are converting from radical form to exponential form.

A. $\sqrt[3]{x} = x^{\frac{1}{3}}$ B. $\sqrt[4]{a^3} = a^{\frac{3}{4}}$ C. $\sqrt[3]{27} = 27^{\frac{1}{3}} = \left(3^3\right)^{\frac{1}{3}} = 3^{3\cdot\frac{1}{3}} = 3^1 = 3$

D. $\sqrt[4]{81x^8y^5} = \left(81x^8y^5\right)^{\frac{1}{4}} = \left(81^{\frac{1}{4}} \cdot x^{8\cdot\frac{1}{4}} \cdot y^{5\cdot\frac{1}{4}}\right) = 3x^2y^{\frac{5}{4}}$

The following examples are converting from exponential form to radical form.

E. $a^{\frac{2}{5}} = \sqrt[5]{a^2}$ F. $32^{\frac{3}{5}} = \left(\sqrt[5]{32}\right)^3 = 2^3 = 8$ G. $\left(a^2b\right)^{\frac{1}{3}} = \sqrt[3]{a^2b}$

H. $\left(2x^3y^4\right)^{\frac{2}{5}} = \left(4x^6y^8\right)^{\frac{1}{5}} = \sqrt[5]{4x^6y^8}$

Now, you try simplifying the following. Convert any radical form to exponential or any exponential to radical form.

15. $\sqrt[5]{32x^8y^5z^{10}}$

$2x^{\frac{8}{5}}yz^2$

16. $\left(27x^3y^6\right)^{\frac{2}{3}}$ $= \sqrt[3]{(27x^3y^6)^2}$

$= (3xy^2)^2 = 9x^2y^4$

17. $\dfrac{32^{\frac{2}{5}}}{32^{\frac{4}{5}}}$ $= \dfrac{4}{16}$

$= \dfrac{1}{4}$

18. $\sqrt[7]{\dfrac{m^{14}n^{28}}{128}}$ $= \dfrac{m^2n^4}{2}$