

- MA.912.A.4.4
Divide polynomials by monomials and polynomials with various techniques, including synthetic division.

Dividing Monomials

Second Law of Exponents

When dividing monomials it is important to remember that

$$\frac{a^5}{a^3} = \frac{aaaaa}{aaa} .$$

It is also important to remember the following.

$$\frac{a}{a} = 1$$

$$a^0 = 1$$

Therefore, the three factors of a in the *denominator* **cancel** three of the five factors of a in the *numerator*. This leaves $a \cdot a$ or a^2 in the numerator and 1 in the denominator.



Remember: To *cancel* means to divide a numerator (the top part of the fraction) and a denominator (the bottom part of the fraction) by a **common factor**. This is done in order to write the fraction in lowest terms or before multiplying the fractions.

$$\begin{array}{c} \text{numerator} \\ \downarrow \\ \frac{aaaaa}{aaa} = \frac{aa}{1} \text{ or } \frac{a^2}{1} = a^2 \\ \uparrow \\ \text{denominator} \end{array}$$

Another way to look at this is

$$\frac{a^5}{a^3} = a^{5-3} = a^2.$$

This is an example of the *second law of exponents*, which states that

$$\frac{a^x}{a^y} = a^{x-y}$$

as long as $a \neq 0$.

Second Law of Exponents

You divide exponential forms by subtracting the exponents.

$$9^7 \div 9^3 = 9^{7-3} = 9^4$$



Remember: The *fraction bar* represents division. So, $\frac{8^4}{8^2}$ means $8^4 \div 8^2$.

$$\frac{9^7}{9^3} = 9^{7-3} = 9^4$$

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

If the exponents are the same,

$$\frac{a^x}{a^x} = 1 \text{ and}$$

$$\frac{a^x}{a^x} = a^{x-x} = a^0 = 1.$$

Any number (except zero) raised to the zero power is equal to 1.

$$a^0 = 1$$

Example

$$\begin{aligned} \frac{x^4 b^3}{x b^3} &= \\ x^{4-1} \cdot \frac{b^3}{b^3} &= \longleftarrow \frac{b^3}{b^3} = 1 \\ x^3 \cdot 1 &= \\ x^3 & \end{aligned}$$

When there are coefficients with variables, simply reduce those as you do when working with fractions.

Example

$$\begin{aligned} \frac{12a^3b^5}{-4ab^3} &= \longleftarrow \frac{\cancel{12}^3}{\cancel{4}_{-1}} = \frac{3}{-1} = -3 \\ -3a^{3-1}b^{5-3} &= \\ -3a^2b^2 & \end{aligned}$$