

Example 1: Multiply the following fractions and simplify your answers completely.

$$\text{a. } -\frac{17a}{9} \cdot \frac{45}{51}$$

$$\text{b. } \frac{12}{7x} \cdot \frac{y^2}{5} \cdot \frac{70}{27x^2}$$

$$\frac{(12)(y^2)(70)}{(7x)(5)(27x^2)}$$

$$\frac{2 \cdot 2 \cdot 3 \cdot y \cdot y \cdot 2 \cdot 5 \cdot 7}{7 \cdot x \cdot 5 \cdot 3 \cdot 3 \cdot 3 \cdot x \cdot x}$$

$$\frac{2 \cdot 2 \cdot 3 \cdot y \cdot y \cdot 2 \cdot 5 \cdot 7}{7 \cdot x \cdot 5 \cdot 3 \cdot 3 \cdot 3 \cdot x \cdot x}$$

$$\frac{8y^2}{9x^3}$$

Steps for Multiplying Rational Expressions:

1. write numerator times numerator and denominator times denominator, but do not actually multiply the polynomials (**leave in factored form**)
2. factor the numerator and denominator completely, then cancel common factors (if possible)

Example 2: Multiply the following rational expressions and simplify your answers completely.

$$\text{a. } \frac{x^7+9x^5}{x^2-9} \cdot \frac{x^2+6x+9}{x^3+3x^2+9x+27}$$

$$\text{b. } \frac{(x+1)^2}{x^2-1} \cdot \frac{1-x^2}{x^2+1}$$

$$\frac{(x+1)(x+1)(-1)(x^2-1)}{(x^2-1)(x^2+1)}$$

$$\frac{(x+1)(x+1)(-1)(x-1)(x+1)}{(x-1)(x+1)(x^2+1)}$$

$$\frac{(x+1)(x+1)(-1)\cancel{(x-1)}(x+1)}{\cancel{(x-1)}(x+1)(x^2+1)}$$

$$\frac{(x+1)(x+1)(-1)}{(x^2+1)}$$

$$-\frac{(x+1)(x+1)}{(x^2+1)}$$

$$c. \frac{5x^2 - 26x - 24}{x^4 + 15x^3 + 54x^2} \cdot \frac{x^8 - 81x^6}{x^2 - 15x + 54}$$

$$\frac{(5x+4)(x-6)}{x^2(x+6)(x+9)} \cdot \frac{x^6(x-9)(x+9)}{(x-9)(x-6)}$$

$$\frac{(5x+4)(x-6)x^6(x-9)(x+9)}{x^2(x+6)(x+9)(x-9)(x-6)}$$

$$\frac{(5x+4)(x-6)x^{\cancel{6}^4}(x-9)(x+9)}{\cancel{x^2}(x+6)(x+9)(x-9)(x-6)}$$

$$\frac{x^4(5x+4)}{x+6}$$

$$d. \frac{x^2+1}{x^3+1} \cdot \frac{x^2-1}{x^3-1} \cdot \frac{3x^3y+3x^2y+3xy}{x^2y^2+y^2-2x^2-2}$$

Answers to Examples:

$$1a. -\frac{5a}{3}; 1b. \frac{8y^2}{9x^3}; 2a. \frac{x^5}{x-3}; 2b. \frac{-(x+1)^2}{x^2+1}; 2c. \frac{x^4(5x^2+4)}{x+6};$$

$$2d. \frac{3xy}{(x^2-x+1)(y^2-2)};$$