

Algebra 2

8.1

Simplify rational expressions

Simplify complex fractions

rational

simplify (a fraction)

GCF

Is it ever OK to divide by zero?

$$\left(\frac{x}{3x+1} \right) \times \cancel{\frac{1}{3}}^{-\frac{1}{3}}$$

$$\begin{array}{r} 2 \overline{) 8} \\ \underline{1 2 8} \\ 2 14 \\ \underline{4 7} \end{array}, \begin{array}{r} 5 \overline{) 6} \\ \underline{1 5 6} \\ 2 2 8 \\ \underline{4 14} \end{array} \quad 8, 7$$

$$\begin{array}{l} 3x+1=0 \\ 3x=-1 \\ \hline x \quad \frac{-1}{3} \end{array}$$

How to simplify fractions:

EX. $8/12$

$10/20$

$25/125$

$$\frac{8 \div 2}{12 \div 2} = \frac{4 \div 2}{6 \div 2} = \frac{2}{3}$$

$$\frac{10 \div 10}{20 \div 10} = \frac{1}{2}$$

$$\frac{25}{125} = \frac{\cancel{5} \cdot \cancel{5}}{\cancel{5} \cdot \cancel{5} \cdot 5} = \frac{1}{5}$$

$$\frac{8}{12} = \frac{2 \cdot \cancel{4}^1}{3 \cdot \cancel{4}_1} = \frac{2}{3}$$

↑
GCF = 4

$$\begin{array}{l} \begin{array}{c} \cancel{3} \\ -3 \end{array} \begin{array}{c} \cancel{1} \\ -1 \end{array} \\ \begin{array}{c} \cancel{4} \\ -4 \end{array} \\ \hline x^2 - 4x + 3 \\ x^2 - 6x + 5 \end{array} \quad \frac{(x-3) \cdot \cancel{(x-1)}}{(x-5) \cdot \cancel{(x-1)}} \quad \frac{(x-3)}{(x-5)}$$

$$\begin{array}{c} \cancel{5} \\ -5 \end{array} \begin{array}{c} \cancel{1} \\ -1 \end{array} \\ \begin{array}{c} \cancel{6} \\ -6 \end{array}$$

Is there a GCF?

$$\frac{8}{12} = \frac{2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 3} = \frac{2}{3}$$

Is there a GCF?

Example 1 Simplify a Rational Expression

a. Simplify $\frac{5x(x^2 + 4x + 3)}{(x - 6)(x^2 - 9)}$

$$\frac{5x(x+1)(x+3)}{(x-6)(x+3)(x-3)}$$

$$\frac{3}{1} \div \frac{3}{4}$$

$$\frac{5x(x+1)}{(x-6)(x-3)}$$

b. Under what conditions is this expression undefined?

$$x-6=0$$
$$x=6$$

$$x^2-9=0$$
$$(x-3)(x+3)=0$$
$$x-3=0 \quad x+3=0$$

$$x \neq 6 \quad x \neq 3$$
$$x \neq -3$$

Is division by zero ever OK?

Find factors...

Standardized Test Example 2 Use Elimination

For what value(s) is $\frac{x^2(x^2 - 5x - 14)}{4x(x^2 + 6x + 8)}$ undefined?

Simplify

$$\frac{x \cdot \cancel{x} (x-7) \cancel{(x+2)}}{4 \cancel{x} (x+4) \cancel{(x+2)}}$$

$$\frac{x(x-7)}{4(x+4)}$$

$$4x = 0$$

$$\underline{4} \quad \underline{4}$$

$$x+4 = 0$$

$$x+2 = 0$$

$$\begin{array}{r} -14 \\ -7 \times 2 = -14 \\ \hline -5 \end{array}$$

$$\begin{array}{r} 8 \\ 4 \times 2 = 8 \\ \hline 6 \end{array}$$

$$x \neq -2$$

$$x \neq 0$$

$$x \neq -4$$

Is there a GCF?

Is division by zero OK?

Guided Practice

$$\frac{6}{8} \times \frac{12}{2}$$

$$\frac{-10}{-5} \times \frac{2}{-3}$$

2. For what value(s) of x is $\frac{x(x^2 + 8x + 12)}{-6(x^2 - 3x - 10)}$ undefined?

Simplify

$$-6x = 0$$

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

$$x - 5 = 0$$

$$x + 2 = 0$$

$$x \neq 5$$

$$x \neq -2$$

are there any common factors?

Example 3 Simplify Using -1

Simplify $\frac{(4w^2 - 3wy)(w + y)}{(3y - 4w)(5w + y)}$.

Common factors?

• **Guided**Practice

Simplify each expression.

3A. $\frac{(xz - 4z)}{z^2(4 - x)}$

When is the expression not defined?

3B. $\frac{ab^2 - 5ab}{(5 + b)(5 - b)}$

Multiplication

$$\frac{2}{9} \cdot \frac{15}{4} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}} \cdot 5}{\cancel{3} \cdot 3 \cdot \underset{1}{\cancel{2}} \cdot 2} = \frac{5}{3 \cdot 2} = \frac{5}{6}$$

$$\frac{2}{9} \cdot \frac{15}{4} = \frac{30}{36} = \frac{5}{6}$$

$$\frac{\cancel{2}}{\cancel{9}} \cdot \frac{\cancel{15}}{\cancel{4}} = \frac{5}{6}$$

Division

$$\frac{3}{5} \div \frac{6}{35} = \frac{3}{5} \cdot \frac{35}{6} = \frac{\overset{1}{\cancel{3}} \cdot \overset{1}{\cancel{5}} \cdot 7}{\cancel{3} \cdot 2 \cdot \underset{1}{\cancel{5}}} = \frac{7}{2}$$

To solve: multiply by the reciprocal...but why?

$$\frac{3}{5} \div \frac{6}{35}$$

$$\frac{3}{5} \cdot \frac{35}{6}$$

$$\frac{3}{5} \cdot \frac{35}{6} = \frac{7}{2}$$

$$\frac{3}{5} \div \frac{6}{35}$$

$$\frac{2}{1} 2 \div 1$$

$$\frac{\frac{3}{5} \cdot \frac{35}{6}}{\left(\frac{6}{35} \cdot \frac{35}{6} \right)} = \frac{\quad}{1}$$

Example 4 Multiply and Divide Rational Expressions

Simplify each expression.

a. $\frac{6c}{5d} \cdot \frac{15cd^2}{8a}$

$$\frac{\cancel{2} \cdot \cancel{3} \cdot \cancel{c} \cdot \cancel{3} \cdot \cancel{5} \cdot \cancel{c} \cdot \cancel{d}}{\cancel{5} \cdot \cancel{2} \cdot \cancel{2} \cdot \cancel{2} \cdot a} = \frac{9c^2d}{4a}$$

$$b. \frac{18xy^3}{7a^2b^2} \cdot \frac{12x^2y}{35a^2b}$$

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

$$\frac{216x^3y^4}{245a^4b^3}$$

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

$$\frac{15y^2}{2bx}$$

► **Guided**Practice

4A. $\frac{12c^3d^2}{21ab} \cdot \frac{14a^2b}{8c^2d} = acd$

4B. $\frac{6xy}{15ab^2} \cdot \frac{21a^3}{18x^4y}$

$$\textcircled{4C.} \frac{16mt^2}{21a^4b^3} \div \frac{24m^3}{7a^2b^2}$$

$$4D. \frac{12x^4y^2}{40a^4b^4} \div \frac{6x^2y^4}{16a^2x}$$

$$\frac{\cancel{2}\cancel{2}\cancel{2}\cancel{2}m\cancel{t}\cancel{t}}{3\cancel{7}\cancel{a}\cancel{a}\cancel{a}\cancel{b}\cancel{b}\cancel{b}} \cdot \frac{\cancel{7}\cancel{a}\cancel{a}\cancel{b}\cancel{b}}{\cancel{8}\cdot\cancel{2}\cdot\cancel{2}\cdot 3m\cancel{m}\cancel{m}}$$

$$\frac{2t^2}{9a^2bm^2}$$

$$\left(\frac{a^3 b^3}{x y^4} \right) \frac{x^2 y}{a^2 b}$$

$$\frac{a b^2 x}{y^3}$$