

## 8.1 Multiplying and Dividing Rational Expressions

## Honors Algebra 2

**Rational Expression:** a ratio of two polynomial expressions

$$\text{ex) } \frac{x}{33-y}$$

$$\text{ex) } \frac{100}{10+x}$$

Simplify the following expressions if possible:

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

$\frac{8+x}{2}$  cannot be simplified further  
\* can't cancel w/ + or -

1. Simplify the following:

<p>a. <math>\frac{5x(x^2+4x+3)}{(x-6)(x^2-9)} = \frac{5x \cancel{(x+3)}(x+1)}{(x-6)\cancel{(x-3)}\cancel{(x+3)}}</math></p> $= \frac{5x(x+1)}{(x-6)(x-3)}$	<p>b. <math>\frac{4y(y-3)(y+4)}{y(y^2-y-6)}</math></p> $= \frac{4 \cancel{y} \cancel{(y-3)}(y+4)}{\cancel{y} \cancel{(y-3)}(y+2)}$ $= \frac{4(y+4)}{y+2}$
<p>c. <math>\frac{2z(z+5)(z^2+2z-8)}{(z-1)(z+5)(z-2)}</math></p> $= \frac{2z \cancel{(z+5)}(z+4)\cancel{(z-2)}}{\cancel{(z-1)}\cancel{(z+5)}\cancel{(z-2)}}$ $= \frac{2z(z+4)}{z-1}$	<p>d. <math>\frac{x^2-5x-24}{x^2-64}</math></p> $= \frac{\cancel{(x-8)}(x+3)}{\cancel{(x-8)}(x+8)}$ $= \frac{x+3}{x+8}$

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

$$= \frac{w(4w-3y)(w+y)}{(3y-4w)(5w+y)}$$

$$= \frac{w \cancel{(4w-3y)} (w+y)}{(-1) \cancel{(4w-3y)} (5w+y)}$$

$$= - \frac{w(w+y)}{5w+y}$$

$$= \frac{-w(w+y)}{5w+y}$$

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

$$= \frac{z(x-4)}{z^2(4-x)}$$

$$= \frac{\cancel{z}(-1)\cancel{(4-x)}}{\cancel{z^2}(4-x)} = \frac{-1}{z}$$

$$= \frac{-1}{z}$$

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

$$= \frac{(ab)(b-5)}{(5+b)(5-b)}$$

$$= \frac{(ab)(-1)\cancel{(5-b)}}{(5+b)\cancel{(5-b)}}$$

$$= \frac{-ab}{5+b}$$

h.  $\frac{a^2x-b^2x}{by-ay}$

$$= \frac{x(a^2-b^2)}{y(b-a)}$$

$$= \frac{x(a-b)(a+b)}{y(b-a)}$$

factor -1 from here

$$= \frac{x(-1)\cancel{(b-a)}(a+b)}{y\cancel{(b-a)}}$$

$$= \frac{-x(a+b)}{y}$$

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2. What values make the functions below undefined:

<p>a. <math>\frac{x^2(x^2-5x-14)}{4x(x^2+6x+8)}</math> <span style="font-size: small; margin-left: 20px;">* can't divide by 0 so where is den = 0</span></p> $= \frac{x^2(x^2-5x-14)}{4x(x+4)(x+2)}$ <p style="text-align: center; margin-top: 20px;"><math>x \neq 0, -4, -2</math></p>	<p>b. <math>\frac{x(x^2+8x+12)}{-6(x^2-3x-10)}</math></p> $= \frac{x(x^2+8x+12)}{-6(x-5)(x+2)}$ <p style="text-align: center; margin-top: 20px;"><math>x \neq 5, -2</math></p>
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3. Multiply and Divide the following rational expressions. Be sure to simplify the answer.

<p>a. <math>\frac{6c}{5d} \cdot \frac{15cd^2}{8a}</math></p> $= \frac{\cancel{6}^3 c}{\cancel{5}^3 d} \cdot \frac{\cancel{15}^3 \cancel{c}^1 \cancel{d}^2}{\cancel{8}^4 a}$ $= \frac{3c}{1} \cdot \frac{3cd}{4a}$ $= \frac{9c^2d}{4a}$	<p>b. <math>\frac{18xy^3}{7a^2b^2} \div \frac{12x^2y}{35a^2b}</math></p> $= \frac{\cancel{18}^3 \cancel{y}^3}{\cancel{7}^2 a^2 \cancel{b}^2} \cdot \frac{\cancel{35}^5 a^2 \cancel{b}}{\cancel{12}^2 x^2 \cancel{y}}$ $= \frac{3y^2}{b} \cdot \frac{5}{2x}$ $= \frac{15y^2}{2bx}$
<p>c. <math>\frac{12c^3d^2}{21ab} \cdot \frac{14a^2b}{8c^2d}</math></p> $= \frac{\cancel{12}^3 \cancel{c}^3 \cancel{d}^2}{\cancel{21}^3 a \cancel{b}} \cdot \frac{\cancel{14}^2 a^2 \cancel{b}}{\cancel{8}^2 \cancel{c}^2 \cancel{d}}$ $= \frac{\cancel{3}^3 c d}{\cancel{3}^3} \cdot \frac{\cancel{2}^2 a}{\cancel{2}^2}$ $= acd$	<p>d. <math>\frac{16m^2}{21a^4b^3} \div \frac{24m^3}{7a^2b^2}</math></p> $= \frac{\cancel{16}^2 m^2}{\cancel{21}^3 a^4 \cancel{b}^3} \cdot \frac{\cancel{7}^2 a^2 \cancel{b}^2}{\cancel{24}^3 m^3}$ $= \frac{2t^2}{3a^2b} \cdot \frac{1}{3m^2}$ $= \frac{2t^2}{9a^2bm^2}$

1) factor 1st

2) cancel

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e.  $\frac{x^2-6x-16}{x^2-16x+64} \cdot \frac{x-8}{x^2+5x+6}$

$$= \frac{\cancel{(x-8)}(x+2)}{\cancel{(x-8)}\cancel{(x-8)}} \cdot \frac{\cancel{x-8}}{(x+3)\cancel{(x+2)}}$$

$$= \frac{1}{x+3}$$

f.  $\frac{x^2-16}{12y+36} \div \frac{x^2-12x+32}{y^2-3y-18}$

$$= \frac{(x-4)(x+4)}{12(y+3)} \cdot \frac{y^2-3y-18}{x^2-12x+32}$$

$$= \frac{\cancel{(x-4)}(x+4)}{12\cancel{(y+3)}} \cdot \frac{(y-6)\cancel{(y+3)}}{(x-8)\cancel{(x+4)}}$$

$$= \frac{(x+4)(y-6)}{12(x-8)}$$

g.  $\frac{8x-20}{x^2+2x-35} \cdot \frac{x^2-7x+10}{4x^2-16}$

$$= \frac{4\cancel{(x-5)}}{(x+7)\cancel{(x-5)}} \cdot \frac{(x-5)(x-2)}{4(x^2-4)}$$

$$= \frac{\cancel{4}}{x+7} \cdot \frac{(x-5)\cancel{(x-2)}}{4\cancel{(x-2)}(x+2)}$$

$$= \frac{x-5}{(x+7)(x+2)}$$

h.  $\frac{x^2-9x+20}{x^2+10x+21} \div \frac{x^2-x-12}{6x+42}$

$$= \frac{x^2-9x+20}{x^2+10x+21} \cdot \frac{6x+42}{x^2-x-12}$$

$$= \frac{\cancel{(x-4)}(x-5)}{\cancel{(x+7)}(x+3)} \cdot \frac{6\cancel{(x+7)}}{\cancel{(x-4)}(x+3)}$$

$$= \frac{6(x-5)}{(x+3)^2}$$

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4. Simplify each complex fraction

$$\text{a. } \frac{\frac{a+b}{4}}{\frac{a^2+b^2}{4}}$$

$$= \frac{a+b}{4} \div \frac{a^2+b^2}{4}$$

$$= \frac{a+b}{\cancel{4}} \cdot \frac{\cancel{4}}{a^2+b^2}$$

\*cant factor

$$= \frac{a+b}{a^2+b^2}$$

$$\text{b. } \frac{\frac{x^2}{x^2-y^2}}{\frac{4x}{y-x}}$$

$$= \frac{x^2}{x^2-y^2} \div \frac{4x}{y-x}$$

$$= \frac{x^2}{x^2-y^2} \cdot \frac{y-x}{4x}$$

$$= \frac{x^2}{(x-y)(x+y)} \cdot \frac{y-x}{4x}$$

$$= \frac{\cancel{x^2}}{(x-y)(x+y)} \cdot \frac{(-1)\cancel{(x-y)}}{4\cancel{x}} = \frac{-x}{4(x+y)}$$

$$\text{c. } \frac{\frac{(x-2)^2}{2(x^2-5x+4)}}{\frac{x^2-4}{4x-10}}$$

$$= \frac{(x-2)^2}{2(x^2-5x+4)} \cdot \frac{4x-10}{x^2-4}$$

$$= \frac{\cancel{(x-2)}^2}{\cancel{2}(x-4)(x-1)} \cdot \frac{\cancel{2}(x-5)}{\cancel{(x-2)}(x+2)}$$

$$= \frac{(x-2)(x-5)}{(x-4)(x-1)(x+2)}$$

$$\text{d. } \frac{\frac{x^2-y^2}{y^2-49}}{\frac{y-x}{y+7}}$$

$$= \frac{x^2-y^2}{y^2-49} \cdot \frac{y+7}{y-x}$$

$$= \frac{(x-y)(x+y)}{(y-7)(y+7)} \cdot \frac{y+7}{y-x}$$

$$= \frac{(-1)(y-x)(x+y)}{(y-7)(y+7)} \cdot \frac{\cancel{y+7}}{\cancel{y-x}}$$

$$= \frac{-(x+y)}{y-7}$$

