

### Multiplying and Dividing Rational Expressions

recall these operations with fractions:

Simplify each of the following

$$\frac{1}{2} \cdot \frac{-3}{5}$$

$$= \frac{-3}{10}$$

$$\frac{12}{27} \div \frac{20}{15}$$

$$= \frac{\overset{4}{\cancel{12}}}{\underset{3}{\cancel{27}}} \cdot \frac{\overset{3}{\cancel{15}}}{\underset{4}{\cancel{20}}}$$

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

$$\frac{\overset{10}{\cancel{50}}}{\underset{9}{\cancel{27}}} \cdot \frac{\overset{-1}{\cancel{3}}}{\underset{5}{\cancel{15}}} = \frac{-150}{135}$$

$$= \frac{-30}{27}$$

$$= \frac{-10}{9}$$

$$\frac{1}{\frac{1}{3}} = 1 \times \frac{3}{1}$$

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### Multiplying and Dividing Rational Expressions

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Steps:

1. Factor the numerator and denominator separately.
2. Perform the mathematical operation.
3. Identify restrictions (where could any denominator = 0).
4. Divide out common factors to simplify.

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Ex.1 Simplify and state any restrictions

(a)  $\frac{\cancel{x}^1}{\cancel{4}^1} \cdot \frac{\cancel{12}^3}{x^2}$   $\frac{\cancel{x}}{\cancel{x} \cdot x} = \frac{1}{x}$

$$= \frac{3}{x}, x \neq 0$$

VA:  $x = 0$

Steps:

1. Factor the numerator and denominator separately.
2. Perform the mathematical operation.
3. Identify restrictions (where could any denominator = 0).
4. Divide out common factors to simplify.

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(b)

Steps:

1. Factor the numerator and denominator separately.
2. Perform the mathematical operation.
3. Identify restrictions (where could any denominator = 0).
4. Divide out common factors to simplify.

$$\frac{-5x^3}{3y} \div \frac{y}{25x^2}$$

$$= \frac{-5x^3}{3y} \cdot \frac{25x^2}{y}$$

$$= \frac{-125x^5}{3y^2}, y \neq 0, x \neq 0$$

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$$(c) \frac{2x+4}{x^2-9} \div \frac{x^2-4}{x^2-2x-3}$$

$$= \frac{2(x+2)}{(x-3)(x+3)} \div \frac{(x-2)(x+2)}{(x-3)(x+1)}$$

$$= \frac{2\cancel{(x+2)}}{\cancel{(x-3)}(x+3)} \cdot \frac{\cancel{(x-3)}(x+1)}{(x-2)\cancel{(x+2)}}$$

$x \neq 3 \quad \text{hole}$

$x \neq -3 \quad \text{VA}$

$x \neq 2 \quad \text{VA}$

$x \neq -2 \quad \text{hole}$

$x \neq -1 \quad \text{hole}$

$$= \frac{2(x+1)}{(x+3)(x-2)}$$

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$$(d) \left[ \frac{3a+6}{9a^2} \div \frac{a+2}{-3a} \right] \cdot \frac{15a}{2}$$

$$= \left[ \frac{3(a+2)}{9a^2} \div \frac{a+2}{-3a} \right] \cdot \frac{15a}{2}$$

Note: Order of Operations, left to right

$$= \left[ \frac{\cancel{3}(a+2)}{\cancel{9}a^2} \cdot \frac{\cancel{-3}a}{\cancel{(a+2)}} \right] \cdot \frac{15a}{2}$$

$$= \frac{-15}{2}, \quad a \neq 0, a \neq -2$$

hole      hole

Assigned Work:

p.50 # 5ad, 6adgh, 7ae, 8ab, 18

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Assigned Work:

p.50 # 5ad, 6ad, 7ae, 8ab, 18

6(a)  $\frac{4x+4}{3x-3} \cdot \frac{6x-6}{5x+5}$

$= \frac{4(x+1)}{3(x-1)} \cdot \frac{6(x-1)}{5(x+1)}$

$= \frac{8}{5}, x \neq 1, x \neq -1$   
 or  
 $x \neq \pm 1$

g)  $\frac{4x-6}{8x^2y} \cdot \frac{4xy}{6x-9}$

$= \frac{2(2x-3)}{4x^2y} \cdot \frac{4xy}{3(2x-3)}$

$= \frac{1}{3x}, x \neq \frac{3}{2}, y \neq 0, x \neq 0$

$2x-3=0$   
 $2x=3$   
 $x=\frac{3}{2}$

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7(e)  $\frac{2x^2-5x-3}{2x^2-11x+15} \cdot \frac{4x^2-8x-5}{4x^2+4x+1}$

$= \frac{(x-3)(2x+1)}{(2x-5)(x-3)} \cdot \frac{(2x-5)(2x+1)}{(2x+1)(2x+1)}$

$= 1, x \neq 3, \frac{5}{2}, -\frac{1}{2}$

8(a)  $\frac{x^2-xy-20y^2}{x^2-8xy+15y^2} \div \frac{x^2+2xy-8y^2}{x^2-xy-6y^2}$

$x^2-x-20 = (x-5)(x+4)$   
 $x^2-xy-20y^2 = (x-5y)(x+4y)$

$= \frac{(x-5y)(x+4y)}{(x-5y)(x-5y)} \cdot \frac{(x-3y)(x+2y)}{(x+4y)(x-2y)}$

$= \frac{x+2y}{x-2y}, x \neq 3y$   
 $x \neq 5y$   
 $x \neq -4y$   
 $x \neq 2y$   
 $x \neq -2y$

$x-3y=0$   
 $x=3y$   
 $y \neq \frac{x}{3}$

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$$\begin{aligned} 18 \quad & \frac{4x^2 - 8x + 4}{2x^2 + 5x - 3} \\ & = \frac{4(x-1)^2}{(x+3)(2x-1)} \end{aligned}$$

Simplified answer.

①      ②      ③      ④

①:  $\frac{4(x-1)^2}{(x+3)(2x-1)} \cdot \frac{(x+1)}{(x+1)}$

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