## MULTIPLYING AND DIVIDING RATIONAL NUMBERS

Prime factors

$$\begin{array}{r|l} 20 & 2 \\ 10 & 2 \\ 5 & 5 \\ 1 & \end{array} \qquad \begin{array}{r|l} 6 & 2 \\ 3 & 3 \\ 1 & \end{array}$$

To multiply or divide rational *expressions* we use the same techniques as with rational *numbers*.

Ex1. $\frac{3}{5}\times\frac{2}{7} = \frac{3\cdot 2}{5\cdot 7} = \frac{6}{35}$

Ex2. $\frac{9}{5}\times\frac{20}{6} = \frac{9\cdot 20}{5\cdot 6} = \frac{3\cdot 3\cdot 2\cdot 2\cdot 5}{5\cdot 2\cdot 3} = 6$

Ex3. $\frac{3}{5}\div\frac{9}{2} = \frac{3}{5}\times\frac{2}{9} = \frac{3\cdot 2}{5\cdot 9} = \frac{3\cdot 2}{5\cdot 3\cdot 3} = \frac{2}{15}$

## MULTIPLYING AND DIVIDING RATIONAL EXPRESSIONS

For rational expressions $\frac{P}{Q}$ and $\frac{R}{S}$:

$\frac{P}{Q}\times\frac{R}{S}=\frac{PR}{QS}$ with restrictions $Q \neq 0$, $S \neq 0$

$\frac{P}{Q}\div\frac{R}{S}=\frac{P}{Q}\times\frac{S}{R}=\frac{PS}{QR}$ with restrictions $Q \neq 0$, $S \neq 0$, $R \neq 0$

**Ex1.** $\frac{x+1}{x^2-x-6}\times\frac{x^2-7x+12}{x^2-16}$

Restrictions

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

2) Restrictions $x \neq -2$, $x \neq 3$, $x \neq 4$, $x \neq -4$

2) Multiply $= \frac{(x+1)\cancel{(x-3)}\cancel{(x-4)}}{(x+2)\cancel{(x-3)}\cancel{(x-4)}(x+4)}$

$= \frac{(x+1)}{(x+2)(x+4)}$ $\boxed{x \neq -4, -2, 3 \text{ and } 4}$

**Ex2.** $\frac{2x-4}{x^2+9x+20}\div\frac{x^2+x-6}{x^2+7x+12}$

1) Factor $\frac{2(x-2)}{(x+4)(x+5)}\div\frac{(x-1)(x+6)}{(x+3)(x+4)}$ $x \neq -4$, $x \neq -3$, $x \neq -5$

flip $= \frac{2(x-2)}{(x+4)(x+5)}\times\frac{(x+3)(x+4)}{(x-1)(x+6)}$ $x \neq 1$, $x \neq -6$

simpl $= \frac{2(x-2)(x+3)\cancel{(x+4)}}{\cancel{(x+4)}(x+5)(x-1)(x+6)}$

$= \frac{2(x-2)(x+3)}{(x+5)(x-1)}$ $x \neq -6, -5, -4, -3 \text{ and } 1$

**SUMMARY**

- Factor numerators and denominators
- Note restrictions on the variables (denominators, and numerators of divisors)
- If applicable, rewrite division as multiplication by the reciprocal
- Write as a single rational expression
- Reduce by cancelling common factors
- Write the simplified rational expression
- Formally state all restrictions on the domain

**COMPLETE: p.121 #(1-5)bd, 6 - 10, 12 and 13**