**Questions**

**1.** Simplify $\dfrac{x^2+3x-10}{x^2+x-20} \cdot \dfrac{x^2-3x-4}{x^2+4x+3}$.

**2.** Simplify $\dfrac{x^2-x-20}{x^2-3x-10} \cdot \dfrac{x^2+7x+10}{x^2+4x-5}$.

**3.** Simplify $(6x-5) \div \dfrac{36x^2-25}{6x^2+17x+10}$.

**4.** Simplify $\dfrac{4x^2-9}{4x^2+12x+9} \div (6x-9)$.

**5.** Simplify $\dfrac{3x^2+12xy+12y^2}{x^2+4xy+3y^2} \div \dfrac{4x+8y}{x+y}$.

**6.** Simplify $\dfrac{5y^2+17y+6}{10y^2+9y+2} \cdot \dfrac{4y^2-1}{2y^2+5y-3}$.

**7.** Simplify $\dfrac{x^2+8x+15}{2x^2+11x+5} \div \dfrac{x^2+6x+9}{2x^2-7x-4}$.

**Solutions**

**1.** Simplify $\dfrac{x^2+3x-10}{x^2+x-20}\cdot\dfrac{x^2-3x-4}{x^2+4x+3}$. Factor all polynomials:

$$\begin{aligned}
x^2+3x-10 &= (x-2)(x+5) \text{ two numbers whose product is } -10 \text{ sum is } 3\text{: } -2,5\\
x^2-3x-4 &= (x-4)(x+1) \text{ two numbers whose product is } -4 \text{ sum is } -3\text{: } -4,1\\
x^2+x-20 &= (x+5)(x-4) \text{ two numbers whose product is } -20 \text{ sum is } 1\text{: } -4,5\\
x^2+4x+3 &= (x+3)(x+1) \text{ two numbers whose product is } 3 \text{ sum is } 4\text{: } 1,3
\end{aligned}$$

$$\begin{aligned}
\frac{x^2+3x-10}{x^2+x-20}\cdot\frac{x^2-3x-4}{x^2+4x+3} &= \frac{(x^2+3x-10)(x^2-3x-4)}{(x^2+x-20)(x^2+4x+3)} \text{ Simplify polynomial multiplication.}\\
&= \frac{(x-2)\cancel{(x+5)}\cancel{(x-4)}\cancel{(x+1)}}{\cancel{(x+5)}\cancel{(x-4)}(x+3)\cancel{(x+1)}}\\
&= \frac{x-2}{x+3} \text{ and } x-4\neq 0, x+1\neq 0, x+5\neq 0
\end{aligned}$$

**2.** Simplify $\dfrac{x^2-x-20}{x^2-3x-10}\cdot\dfrac{x^2+7x+10}{x^2+4x-5}$. Factor all polynomials:

$$\begin{aligned}
x^2-x-20 &= (x-5)(x+4) \text{ two numbers whose product is } -20 \text{ sum is } -1\text{: } -5,4\\
x^2-3x-10 &= (x-5)(x+2) \text{ two numbers whose product is } -10 \text{ sum is } -3\text{: } -5,2\\
x^2+7x+10 &= (x+5)(x+2) \text{ two numbers whose product is } 10 \text{ sum is } 7\text{: } 5,2\\
x^2+4x-5 &= (x+5)(x-1) \text{ two numbers whose product is } -5 \text{ sum is } 4\text{: } 5,-1
\end{aligned}$$

$$\begin{aligned}
\frac{x^2-x-20}{x^2-3x-10}\cdot\frac{x^2+7x+10}{x^2+4x-5} &= \frac{(x^2-x-20)(x^2-3x-10)}{(x^2+7x+10)(x^2+4x-5)} \text{ Simplify polynomial multiplication.}\\
&= \frac{\cancel{(x-5)}(x+4)\cancel{(x+5)}\cancel{(x+2)}}{\cancel{(x-5)}\cancel{(x+2)}\cancel{(x+5)}(x-1)}\\
&= \frac{x+4}{x-1} \text{ and } x+5\neq 0, x-5\neq 0, x+2\neq 0
\end{aligned}$$

**3.** Simplify $(6x-5)\div\dfrac{36x^2-25}{6x^2+17x+10}$. Factor all polynomials:

$$\begin{aligned}
6x^2+17x+10 &= 6x^2+12x+5x+10 \text{ two numbers whose product is } 60 \text{ sum is } 17\text{: } 12,5\\
&= 6x(x+2)+5(x+2) \text{ Factor by grouping}\\
&= (6x+5)(x+2)\\
36x^2-25 &= (6x-5)(6x+5) \text{ Difference of squares}
\end{aligned}$$

$$\begin{aligned}
(6x-5)\div\frac{36x^2-25}{6x^2+17x+10} &= (6x-5)\cdot\frac{6x^2+17x+10}{36x^2-25} \text{ Simplify polynomial division.}\\
&= \frac{(6x-5)(6x^2+17x+10)}{(36x^2-25)} \text{ Simplify polynomial multiplication.}\\
&= \frac{\cancel{(6x-5)}\cancel{(6x+5)}(x+2)}{\cancel{(6x-5)}\cancel{(6x+5)}}\\
&= x+2 \text{ and } 6x+5\neq 0, 6x-5\neq 0
\end{aligned}$$

**4.** Simplify $\dfrac{4x^2-9}{4x^2+12x+9} \div (6x-9)$. Factor all polynomials:

$$\begin{aligned}
4x^2+12x+9 &= 4x^2+6x+6x+9 \text{ two numbers whose product is 36 sum is 12: } 6,6\\
&= 2x(2x+3)+3(2x+3) \text{ Factor by grouping}\\
&= (2x+3)(2x+3) \text{ hey–this was a perfect square!}\\
4x^2-9 &= (2x+3)(2x-3) \text{ Difference of squares}\\
6x-9 &= 3(2x-3) \text{ common factor}
\end{aligned}$$

$$\begin{aligned}
\frac{4x^2-9}{4x^2+12x+9} \div (6x-9) &= \frac{4x^2-9}{4x^2+12x+9} \cdot \frac{1}{(6x-9)} \text{ Simplify polynomial division.}\\
&= \frac{(4x^2-9)}{(4x^2+12x+9)(6x-9)} \text{ Simplify polynomial multiplication.}\\
&= \frac{\cancel{(2x-3)}\cancel{(2x+3)}}{(2x+3)\cancel{(2x+3)}3\cancel{(2x-3)}}\\
&= \frac{1}{3(2x+3)} \text{ and } 2x-3\neq 0, 2x+3\neq 0
\end{aligned}$$

**5.** Simplify $\dfrac{3x^2+12xy+12y^2}{x^2+4xy+3y^2} \div \dfrac{4x+8y}{x+y}$. Factor all polynomials (let the $y$ tag along with the constants):

$$\begin{aligned}
3x^2+12xy+12y^2 &= 3x^2+6xy+6xy+12y^2 \text{ two numbers whose product is 36 sum is 12: } 6,6\\
&= 3x(x+2y)+6y(x+2y) \text{ Factor by grouping}\\
&= (3x+6y)(x+2y) = 3(x+2y)(x+2y) \text{ hey–this was a perfect square!}\\
x^2+4xy+3y^2 &= (x+1y)(x+3y) = (x+y)(x+3y) \text{ two numbers whose product is 3 sum is 4: } 1,3\\
4x+8y &= 4(x+2y) \text{ common factor}
\end{aligned}$$

$$\begin{aligned}
\frac{3x^2+12xy+12y^2}{x^2+4xy+3y^2} \div \frac{4x+8y}{x+y} &= \frac{3x^2+12xy+12y^2}{x^2+4xy+3y^2} \cdot \frac{x+y}{4x+8y} \text{ Simplify polynomial division.}\\
&= \frac{(3x^2+12xy+12y^2)(x+y)}{(x^2+4xy+3y^2)(4x+8y)} \text{ Simplify polynomial multiplication.}\\
&= \frac{3(x+2y)\cancel{(x+2y)}\cancel{(x+y)}}{\cancel{(x+y)}(x+3y)4\cancel{(x+2y)}}\\
&= \frac{3(x+2y)}{4(x+3y)} \text{ and } x+2y\neq 0, x+y\neq 0
\end{aligned}$$

**6.** Simplify $\dfrac{5y^2+17y+6}{10y^2+9y+2}\cdot\dfrac{4y^2-1}{2y^2+5y-3}$. Factor all polynomials:

$$\begin{aligned}
5y^2+17y+6 &= 5y^2+15y+2y+6 \text{ two numbers whose product is 30 sum is 17: } 15, 2\\
&= 5y(y+3)+2(y+3) \text{ Factor by grouping}\\
&= (5y+2)(y+3)\\
10y^2+9y+2 &= 10y^2+5y+4y+2 \text{ two numbers whose product is 20 sum is 9: } 5, 4\\
&= 5y(2y+1)+2(2y+1) \text{ Factor by grouping}\\
&= (5y+2)(2y+1)\\
2y^2+5y-3 &= 2y^2+6y-1y-3 \text{ two numbers whose product is } -6 \text{ sum is 5: } 6, -1\\
&= 2y(y+3)-1(y+3) \text{ Factor by grouping}\\
&= (2y-1)(y+3)\\
4y^2-1 &= (2y-1)(2y+1) \text{ difference of squares}
\end{aligned}$$

$$\begin{aligned}
\frac{5y^2+17y+6}{10y^2+9y+2}\cdot\frac{4y^2-1}{2y^2+5y-3} &= \frac{(5y^2+17y+6)(4y^2-1)}{(10y^2+9y+2)(2y^2+5y-3)} \text{ Simplify polynomial multiplication.}\\
&= \frac{\cancel{(5y+2)}\cancel{(y+3)}\cancel{(2y+1)}\cancel{(2y-1)}}{\cancel{(5y+2)}\cancel{(2y+1)}\cancel{(2y-1)}\cancel{(y+3)}}\\
&= 1 \text{ and } 5y+2\neq 0, y+3\neq 0, 2y+1\neq 0, 2y-1\neq 0
\end{aligned}$$

**7.** Simplify $\dfrac{x^2+8x+15}{2x^2+11x+5}\div\dfrac{x^2+6x+9}{2x^2-7x-4}$. Factor all polynomials:

$$\begin{aligned}
x^2+8x+15 &= (x+5)(x+3) \text{ two numbers whose product is 15 sum is 8: } 5, 3\\
2x^2+11x+5 &= 2x^2+10x+1x+5 \text{ two numbers whose product is 10 sum is 11: } 10, 1\\
&= 2x(x+5)+1(x+5) \text{ Factor by grouping}\\
&= (2x+1)(x+5)\\
2x^2-7x-4 &= 2x^2-8x+1x-4 \text{ two numbers whose product is } -8 \text{ sum is } -7: \ -8, 1\\
&= 2x(x-4)+1(x-4) \text{ Factor by grouping}\\
&= (2x+1)(x-4)\\
x^2+6x+9 &= (x+3)(x+3) \text{ two numbers whose product is 9 sum is 6: } 3, 3
\end{aligned}$$

$$\begin{aligned}
\frac{x^2+8x+15}{2x^2+11x+5}\div\frac{x^2+6x+9}{2x^2-7x-4} &= \frac{x^2+8x+15}{2x^2+11x+5}\cdot\frac{2x^2-7x-4}{x^2+6x+9} \text{ Simplify polynomial division.}\\
&= \frac{(x^2+8x+15)(2x^2-7x-4)}{(2x^2+11x+5)(x^2+6x+9)}\cdot\frac{2x^2-7x-4}{x^2+6x+9} \text{ Simplify polynomial multiplication.}\\
&= \frac{\cancel{(x+5)}\cancel{(x+3)}\cancel{(2x+1)}(x-4)}{\cancel{(2x+1)}\cancel{(x+5)}\cancel{(x+3)}(x+3)}\\
&= \frac{x-4}{x+3} \text{ and } x+5\neq 0, x+3\neq 0, 2x+1\neq 0
\end{aligned}$$