Add, Subtract, Multiply and Divide Rational Expressions

$$\frac{4}{5} \times \frac{7}{10} =$$
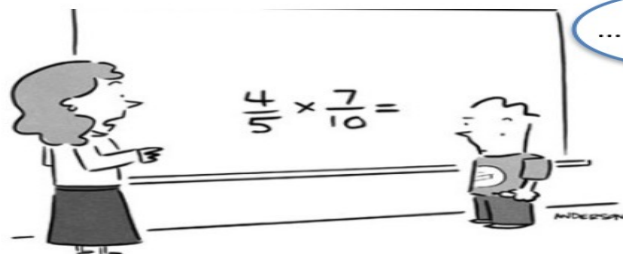
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"Actually, ninjas multiply fractions all the time.
They just never talk about it. Because they're ninjas."

Old School Fractions Operations

$$\frac{4}{5} + \frac{3}{10} - \frac{1}{20} =$$

$$\frac{3}{4} \cdot \frac{5}{6} \cdot \frac{1}{2} =$$

$$\frac{3}{5} \div \frac{6}{7} =$$

Domains and Factoring to Simplify

$$\frac{0}{5} =$$

$$\frac{5}{0} =$$

$$\frac{3x+15}{x+5}$$

$$\frac{4}{x-3}$$

$$\frac{x}{x^2+5x+4}$$

$$\frac{x^2-3x+2}{x^2+3x-10}$$

REVIEW: Factoring Techniques and Cancelling Techniques

Factoring out a common term and factor again	Factoring out a common term and factor again
$2x^2 - 8x - 42$	$2x^2 - 72$

Factoring when leading coefficient is not 1.	Sum/Difference of Cubes
$2x^2 - 13x + 20$	$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$ $x^3 + 8$

Factoring out a negative to flip signs	Cancelling out common terms
$-x + 6$ $\qquad\qquad \dfrac{-2x+6}{x-3}$	$\dfrac{4x^3 yz^5}{10x^5 yz^2}$ $\qquad\qquad \dfrac{4(x+2)(x-3)}{8(x-2)(x-3)}$

Add or Subtract and Simplify

All the examples below have *LIKE DENOMINATORS and require NO simplification*

$$\frac{4}{x+5}+\frac{7}{x+5}$$

$$\frac{5x}{x+5}-\frac{2x}{x+5}$$

$$\frac{2x-7}{x+3}+\frac{x}{x+3}$$

$$\frac{2x-3}{x+3}-\frac{5x+1}{x+3}$$

All the examples below have *LIKE DENOMINATORS and require simplification*

$$\frac{2x+7}{(x+5)(x-3)}-\frac{x+10}{(x+5)(x-3)}$$

$$\frac{2x}{x^2+5x+6}-\frac{x-2}{x^2+5x+6}$$

$$\frac{x^2+5x+1}{x+3}-\frac{4x-5}{x+3}+\frac{7x+9}{X+3}$$

Add or Subtract and Simplify

All the examples below have UN*LIKE DENOMINATORS and require NO simplification*

$$\frac{4}{x}+\frac{7}{6x^2}$$

$$\frac{x}{2}-\frac{7}{x-3}$$

$$\frac{5}{2x}+3$$

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

All the examples below have UN*LIKE DENOMINATORS and require simplification*

$$\frac{x-1}{x-2}-\frac{x^2+4x-4}{x^2+4x-12}$$

$$\frac{2x^2}{x^2-4}-\frac{x}{x-2}-\frac{1}{x+2}$$

Multiply or Divide and Simplify

To Multiply Rational Expressions
1. Factor all numerators and denominators completely.
2. Divide out common factors.
3. Multiply numerators together and multiply denominators together.

$$\frac{3x^2}{2y} \cdot \frac{4y^3}{3x}$$

$$(x-5) \cdot \frac{7}{x^3-5x^2}$$

$$\frac{(x+2)^2}{6x^2} \cdot \frac{3x}{x^2-4}$$

$$\frac{3x+2}{2x-1} \cdot \frac{4-8x}{3x+2}$$

$$\frac{2x^2+7x-15}{4x^2-8x+3} \cdot \frac{2x^2+x-1}{x^2+6x+5}$$

To Divide Rational Expressions
Invert the divisor (the second fraction) and multiply.

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

$$\frac{x^2+8x+15}{x^2} \div (x+3)^2$$

$$\frac{12x^2-22x+8}{3x} \div \frac{3x^2+2x-8}{2x^2+4x}$$