

ADD AND SUBTRACT RATIONAL EXPRESSIONS

- ### HOW DO I ADD AND SUBTRACT RATIONAL EXPRESSIONS?
- Steps:
- 1. Factor Denominator
 - 2. Get a Common Denominator
 - 3. Add/Sub Numerator
 - 4. Re-write Denominator
 - 5. Simplify your answer

EX. ADD OR SUBTRACT.

$$\frac{5}{6x^2} + \frac{x}{4x^2 - 12x}$$

$$\frac{5}{6x^2} + \frac{x}{4x(x-3)}$$

$$\frac{10x + 3x^2}{12x^2(x-3)} + \frac{3x^2}{12x^2(x-3)}$$

$$\frac{10x - 30 + 3x}{12x^2(x-3)}$$

$\frac{3x^2 + 10x - 30}{12x^2(x-3)}$

EX. ADD OR SUBTRACT.

$$\frac{x^2 + 3x - 6}{x^2 - 2x - 3} - \frac{3}{x - 3}$$

$$\frac{x^2 + 3x - 6}{(x-3)(x+1)} - \frac{3(x+1)}{(x-3)(x+1)}$$

$$\frac{x^2 + 3x - 6 - 3x - 3}{(x-3)(x+1)}$$

$$\frac{x^2 - 9}{(x-3)(x+1)} = \frac{(x+3)(x-3)}{(x-3)(x+1)} = \frac{x+3}{x+1}$$

EX. ADD OR SUBTRACT.

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

$$\frac{6x - 15x^2 + 4 - 10x + x - 10}{(3x+2)(x-10)}$$

$$\frac{-15x^2 - 3x - 6}{(3x+2)(x-10)} \Rightarrow \frac{-3(x^2+x+2)}{(3x+2)(x-10)}$$

EX. ADD OR SUBTRACT.

$$\frac{4}{3x^2-3} + \frac{4}{x-1} + \frac{5}{6x}$$

$$\frac{4x \cdot 10x}{2(3x-1)(x+1)} + \frac{4(x+1)(x+1)}{(x-1)(x+1)} + \frac{5(x-1)(x+1)}{6x(x-1)(x+1)}$$

$$\frac{40x^2 + 24x^2 + 24x + 5x^2 - 5}{6x(x-1)(x+1)}$$

$$\frac{49x^2 + 24x - 5}{6x(x-1)(x+1)}$$

Add and Subtract Rational Expressions

Name Key

Perform the indicated operation. Simplify your answer.

$$1. \frac{2}{2} \cdot \frac{3a+2}{(a+b)} + \frac{4}{2a+2b}$$

$$\frac{6a+4+4}{2a+2b} = \frac{6a+8}{2a+2b} = \frac{\cancel{2}(3a+4)}{\cancel{2}(a+b)} = \boxed{\frac{3a+4}{a+b}}$$

$$3. \frac{7}{y-8} - \frac{6}{8-y}$$

$$\frac{7}{y-8} + \frac{6}{y-8} = \boxed{\frac{13}{y-8}}$$

$$5. \frac{(a+3)3}{(a-3)a-2} + \frac{2}{a-3} \cdot \frac{(a-2)}{(a-2)}$$

$$\frac{3a-9+2a-4}{(a-3)(a-2)} = \boxed{\frac{5a-13}{(a-3)(a-2)}}$$

$$7. \frac{10}{x^2-3x-28} + \frac{7}{2x-14} \cdot \frac{(x+4)}{(x+4)}$$

$$\frac{10+7x+28}{2(x-7)(x+4)} = \boxed{\frac{7x+38}{2(x-7)(x+4)}}$$

$$9. \frac{(x+y)x}{x-y} - \frac{2x}{x^2-y^2}$$

$$\frac{x^2+xy-2x}{(x-y)(x+y)} = \boxed{\frac{x(x+y-2)}{(x^2-y^2)}}$$

$$11. \frac{(x+4)x}{x+1} - \frac{4(x+4)}{x+4} + \frac{3}{x^2+5x+4}$$

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

$$\frac{(x+1)\cancel{(x-1)}}{(x+4)(x+1)} = \boxed{\frac{x-1}{x+4}}$$

$$2. \frac{5}{5} \cdot \frac{3}{4a} - \frac{2 \cdot 4}{5a-4} \cdot \frac{1}{2a} \cdot 10$$

$$\frac{15-8-10}{20a} = \boxed{\frac{-3}{20a}}$$

$$4. \frac{(x-3)x}{(x-3)x+3} - \frac{6x}{x^2-9}$$

$$\frac{x^2-3x-6x}{x^2-9} = \frac{x^2-9x}{x^2-9} = \boxed{\frac{x(x-9)}{x^2-9}}$$

$$6. \frac{8}{2y-16} - \frac{y}{8-y}$$

$$\frac{8}{2(y-8)} + \frac{y}{(y-8)} \cdot \frac{2}{2} = \frac{8+2y}{2(y-8)} = \frac{\cancel{2}(y+4)}{\cancel{2}(y-8)} = \boxed{\frac{y+4}{y-8}}$$

$$8. \frac{w+12}{4w-16} - \frac{w+4}{2w-8} \cdot \frac{2}{2}$$

$$\frac{w+12-2w-8}{4(w-4)} = \frac{-w+4}{4(w-4)} = \frac{-1(w-4)}{4(w-4)} = \boxed{\frac{-1}{4}}$$

$$10. \frac{(x+2)3}{x^2+3x+2} - \frac{4}{x^2+4x+4} \cdot \frac{(x+1)}{(x+1)}$$

$$\frac{3x+6-4x-4}{(x+2)^2(x+1)} = \boxed{\frac{-x+2}{(x+2)^2(x+1)}}$$

$$12. \frac{(x+4)2x+1}{x^2+2x-15} - \frac{x}{x^2+x-20} \cdot \frac{(x-3)}{(x-3)}$$

$$\frac{2x^2+8x+x+4-x^2+3x}{(x+5)(x-3)(x-4)} = \boxed{\frac{x^2+12x+4}{(x+5)(x-3)(x-4)}}$$

$$13. \frac{2x}{5x+20} + \frac{(6x)5}{(x+4)5}$$

$$\frac{2x + 25x}{5(x+4)} = \boxed{\frac{27x}{5(x+4)}}$$

$$14. \frac{(x-3)8}{(x-3)(x+7)} - \frac{5(x+7)}{(x-3)(x+7)}$$

$$8x-24-5x-35 = \boxed{\frac{3x-59}{(x-3)(x+7)}}$$

$$15. \frac{5(2x)}{5(x-2)} + \frac{x+9}{5(x-2)}$$

$$\frac{10x+x+9}{5(x-2)} = \boxed{\frac{11x+9}{5(x-2)}}$$

$$16. \frac{(x-2)(x+2)}{(x+2)(x+2)} + \frac{x-2}{x^2+4x+4}$$

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

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

$$17. \frac{15x+2}{x^2+6x} - \frac{(x+1)x}{(x+6)x}$$

$$\frac{15x+2-x^2-x}{x(x+6)}$$

$$\boxed{\frac{-x^2+14x+2}{x(x+6)}}$$

$$18. \frac{(x+4)5}{(x+4)x+5} - \frac{(2x-5)}{x^2+9x+20}$$

$$5x+20-2x+5 = \boxed{\frac{3x+25}{(x+5)(x+4)}}$$

$$19. \frac{4 \cdot x}{4 \cdot 4} + \frac{(x-2)(x-4)}{8 \cdot 2 \cdot 16}$$

$$\frac{4x+2x-4-x+4}{16}$$

$$\boxed{\frac{5x}{16}}$$

$$20. \frac{4(4+3a)}{4 \cdot 6} + \frac{(5a)(3-a)^2}{8 \cdot 3 \cdot 12 \cdot 2}$$

$$\frac{16+12a-15a+6-2a}{24}$$

$$= \boxed{\frac{-5a+22}{24}}$$

Math 1
Add and Subtract Rational Expressions

Name: _____
Period: _____

Simplify each expression. Circle your final answer.

$$1. \frac{7}{m} + \frac{3}{m} = \frac{10}{m}$$

$$2. \frac{2a}{a+5} + \frac{a}{a+5} = \frac{3a}{a+5}$$

$$3. \frac{5}{9a} + \frac{4}{9a} = \frac{9}{9a} = \frac{1}{a}$$

$$4. \frac{a}{5a-20} + \frac{-4}{5a-20}$$

$$\frac{a-4}{5(a-4)} = \frac{1}{5}$$

$$5. \frac{-10}{a^2+7a} + \frac{a+17}{a^2+7a}$$

$$\frac{a+7}{a(a+7)} = \frac{1}{a}$$

$$6. \frac{2x^2-5x}{x^2-5x-14} + \frac{x^2-2x+5}{x^2-5x-14}$$

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

$$7. \frac{x^2+6x}{x+4} - \frac{(3x+5)}{x+4} + \frac{1}{x+4}$$

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

$$8. \frac{(2y-3)}{2 \cdot 7} - \frac{3y+1}{14}$$

$$\frac{4y-6-3y-1}{14} = \frac{y-7}{14}$$

$$9. \frac{x}{x-2} - \frac{2}{x-2}$$

$$\frac{x-2}{x-2} = 1$$

$$10. \frac{6}{x+3} + \frac{4(x+3)}{x(x+3)}$$

$$\frac{10x+12}{x(x+3)}$$

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

$$11. \frac{2}{x \cdot x} + \frac{5}{x^2}$$

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

$$12. \frac{(m+1)}{(3m)} + \frac{m+4}{4m(3)}$$

$$\frac{4m+4+3m+12}{12m}$$

$$\frac{7m+16}{12m}$$

Math 1
Operations on Rational Expressions
 Name: _____

Simplify the expression

$$1. \frac{2x^2 - 4x}{x-2} = \frac{2x(x-2)}{x-2} = \boxed{2x}$$

$$7. \frac{12x}{5} \div \frac{6x}{7} = \frac{2\cancel{x}}{5} \cdot \frac{7}{\cancel{6x}} = \boxed{\frac{14}{5}}$$

$$2. \frac{x \cdot 5x}{x \cdot 2} + \frac{1 \cdot 2}{x \cdot 2} = \boxed{\frac{5x^2 + 2}{2x}}$$

$$8. \frac{8}{2+3x} \cdot (8+12x) = \frac{8}{2+3x} \cdot \frac{4(2+3x)}{1} = \boxed{32}$$

$$3. \frac{x-3}{x+1} \div \frac{x^2-3x}{5x-5} = \frac{\cancel{x} \cdot 5(x-1)}{x+1 \cdot x(x-\cancel{3})} = \boxed{\frac{5(x-1)}{x(x+1)}}$$

$$9. \frac{5x}{x-3} - \frac{2x+1}{x-3} = 5x - 2x - 1 = \boxed{\frac{3x-1}{x-3}}$$

$$4. \frac{4}{5x} - \frac{3 \cdot 5}{x \cdot 5} = \frac{4-15}{5x} = \boxed{-\frac{11}{5x}}$$

$$10. \frac{2+3x}{8} \cdot \frac{15-3}{4+6x} = \frac{\cancel{3}}{8} \cdot \frac{3}{2(2+\cancel{3x})} = \boxed{\frac{3}{2}}$$

$$5. \frac{14}{3x} + \frac{x+5}{3x} = \boxed{\frac{x+19}{3x}}$$

$$11. \frac{(x-2)4}{(x-2)x+2} + \frac{3(x+2)}{(x-2)(x+2)} = \frac{4x-8+3x+6}{(x-2)(x+2)} = \boxed{\frac{7x-2}{(x-2)(x+2)}}$$

$$6. \frac{x+3}{x^2+8x+15} = \frac{x+3}{(x+5)(x+3)} = \boxed{\frac{1}{x+5}}$$

$$12. \frac{x^2+3x}{x^2+5x+6} + \frac{4}{x+2} = \frac{\cancel{x}(\cancel{x}+3)}{(\cancel{x}+3)(x+2)} = \frac{x}{x+2} + \frac{4}{x+2} = \boxed{\frac{x+4}{x+2}}$$

Directions: This game is very similar to traditional Tic Tac Toe. Instead of the playing board being 3 blocks wide and 3 blocks tall, this one is 5 squares in each direction. To "win" this game, you must get 5 problems COMPLETELY correct in either the HORIZONTAL or VERTICAL direction. Diagonal doesn't count in this game! Once you think you have the correct answers for your row or column, have the teacher check their accuracy. If YOU are completely correct, you get a circle and win the square. If you are not completely correct, the teacher gets to block you with an X. When you have won the game, your teacher will keep this sheet, and you will be able to start on the next task. Take your time, be careful, and good luck!!

Factor: $2x^2 + 8x + 6$ $2(x^2 + 4x + 3)$ $2(x+3)(x+1)$	Simplify: $\frac{55x^6y^3}{70x^5y^7} = \frac{11x}{14y^4}$	Multiply: $\frac{9x^2 \cdot 8^2}{412 \cdot 8x} = \frac{2x}{2}$ $= x$	Divide: $\frac{5x+15}{3x} \div \frac{x+3}{9x}$ $\frac{5(x+3) \cdot 39x}{7x \cdot x+3}$ $\frac{15}{1}$	Multiply: $\frac{4x}{x+1} \cdot \frac{x^2-6x-7}{x^3+7x^2}$ $\frac{4x \cdot (x-7)(x+1)}{x^2(x^2+7x)}$ $\frac{4(x-7)}{x(x+7)}$
Multiply: $\frac{7x^4 \cdot 8y}{14x \cdot 5y^6} = \frac{28x^3}{35y^5}$	Factor: $5x^2 + 5x + 10$ $5(x^2 + x + 2)$	Simplify: $\frac{90x^3yz^2}{180y^4z} = \frac{1x^3z}{2y^3}$	Multiply: $\frac{4x}{x^2-25} \cdot \frac{x-5}{8x^2+12x}$ $\frac{4x \cdot (x-5)}{(x-5)(x+5) \cdot 4x(2x+3)}$ $\frac{1}{(x+5)(x+3)}$	Divide: $\frac{6x-14}{x^2-1} \div \frac{3x-7}{5x+1}$ $\frac{2(3x-7) \cdot 5x+1}{(x-1)(x+1) \cdot 3x-7}$ $\frac{2(5x+1)}{x-1}$
Divide: $\frac{x+4}{x^2+5x+4} \div \frac{1}{3x+3}$ $\frac{x+4}{(x+4)(x+1)} \cdot \frac{3(x+1)}{1}$ $\frac{3}{1}$	Simplify: $\frac{16x^2y^3z}{30x^4y^5z}$ $\frac{8x^2y^3}{15y^2z}$	Factor: $4x^2 - 36$ $4(x^2 - 9)$ $4(x+3)(x-3)$	Simplify: $\frac{x^2+4x+4}{x^2-4}$ $\frac{(x+2)(x+2)}{(x-2)(x+2)}$ $\frac{x+2}{x-2}$	Multiply: $\frac{x+9}{x^2-81} \cdot \frac{x-9}{3x}$ $\frac{x+9}{(x-9)(x+9)} \cdot \frac{x-9}{3x}$ $\frac{1}{3x}$
Multiply: $\frac{3x}{8x^2} \cdot \frac{4x^4}{3x^8}$ $\frac{12x^5}{24x^{10}} = \frac{1}{2x^5}$	Divide: $\frac{x^2-8x+15}{x^2-3x} \div (3x-15)$ $\frac{(x-3)(x-5)}{x(x-3)} \cdot \frac{1}{3(x-5)}$ $\frac{1}{3x}$	Factor: $2x^3 + 12x^2 + 18x$ $2x(x^2 + 6x + 9)$ $2x(x+3)(x+3)$	Factor: $2x^2 - 8$ $2(x-2)(x+2)$	Simplify: $\frac{2x^2+6x}{8x^2+24x}$ $\frac{2x(x+3)}{8x(x+3)} = \frac{1}{4}$
Simplify: $\frac{4x^2-9}{10x+15}$ $\frac{(2x-3)(2x+3)}{5(2x+3)}$ $\frac{2x-3}{5}$	Multiply: $\frac{4x-8}{x^2-4x+4} \cdot (6x-12)$ $\frac{4(x-2) \cdot 6(x-2)}{(x-2)^2 \cdot 6(x-2)}$ $\frac{24}{1}$	Divide: $\frac{x^2-4x+3}{2x} \div \frac{x-1}{2}$ $\frac{(x-3)(x-1)}{2x} \cdot \frac{2}{x-1}$ $\frac{x-3}{x}$	Divide: $\frac{36x}{10y} \div \frac{12x^4}{15xy^3}$ $\frac{3 \cdot 36x}{2 \cdot 10y} \cdot \frac{3 \cdot 15xy^3}{12x^4}$ $\frac{9x^2y^3}{2x^3y}$	Factor: $x^2 - 12x - 28$ $(x-14)(x+2)$

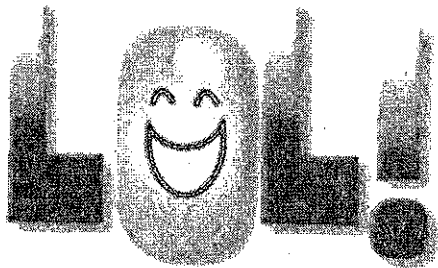
$$= \frac{9y^3}{2x^3}$$

15

Rational Expressions and Complex Fractions

Factor!

- Factor!
- Factor!
- Factor!
- Factor!
- Factor!
- Factor!
- Factor!
- Factor!
- And oh, yeah... Factor!



Ex. Simplify.

$$\begin{aligned}
 1. \frac{(x^3+3x^2)(2x-6)}{x^3+27} &= x^2(x+3) - 2(x+3) \\
 &= \frac{(x^2-2)(x+3)}{(x+3)(x^2+3x+9)} \\
 &= \frac{x^2-2}{x^2+3x+9}
 \end{aligned}$$

$$2. \frac{x^2+11x}{x-2} \div (3x^2+6x) \cdot \frac{x^2-4}{x+11}$$

$$\frac{x(x+11)}{(x-2)} \cdot \frac{1}{3x(x+2)} \cdot \frac{(x+2)(x-2)}{(x+11)}$$

$$\boxed{\frac{1}{3}}$$

$$\begin{aligned}
 3. \quad \frac{\frac{1}{x} - \frac{x}{x^{-1}+1}}{\frac{3}{x}} &= \frac{\frac{1}{x} - \frac{x}{\frac{1}{x} + \frac{x}{x}}}{\frac{3}{x}} \\
 &= \frac{\frac{1}{x} - \frac{x}{\frac{x+1}{x}}}{\frac{3}{x}} \leftarrow \frac{1}{x} - \left(x \cdot \frac{x}{x+1} \right) \\
 &= \frac{\frac{1}{x} - \frac{x^2}{x+1}}{\frac{3}{x}} \\
 &= \frac{\frac{(x+1) - x^2}{(x+1)x}}{\frac{3}{x}} \\
 &= \frac{x+1-x^3}{x(x+1)} = \frac{-x^3+x+1}{x(x+1)} \cdot \frac{x}{3} \\
 &= \frac{-x^2+x+1}{3(x+1)} = \frac{-1(x^2-x-1)}{3(x+1)}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad \frac{\frac{4}{5-x}}{\frac{2(3)}{-5-x} + \frac{1(-1)}{3x-15}} &= \frac{-4}{(x-5)} \cdot \frac{-3(x-5)}{5} \\
 &= \frac{12}{5} \\
 &\downarrow \\
 &\frac{6}{-3(x-5)} + \frac{-1}{-3(x-5)}
 \end{aligned}$$

Rational Expressions and Complex Fractions

Name _____

$$1. \frac{x^3 - 64}{4x^2 - 64} = \frac{(x-4)(x^2 + 4x + 64)}{4(x^2 - 16)}$$

$$= \frac{\cancel{(x-4)}(x^2 + 4x + 64)}{4\cancel{(x-4)}(x+4)}$$

$\frac{x^2 + 4x + 64}{4(x+4)}$

$$2. \frac{c^2 + 3c}{25 - c^2} \cdot \frac{c^2 + 4c - 5}{c^2 + 4c + 3}$$

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

$\frac{c(c-1)}{(5-c)(c+1)}$

$$3. \frac{x^2 - y^2}{y^2 - xy} \cdot \frac{y}{y^3}$$

$$\frac{(x+y)\cancel{(x-y)}}{y\cancel{(x-y)}} \cdot \frac{y}{y^3}$$

$\frac{1}{y(x+y)}$

$$4. \frac{x^2 + 4x}{x^3 + 10x^2} \div \frac{x-3}{9-x^2} \cdot \frac{x+10}{x^2 + 7x + 12}$$

$$\frac{x(x+4)}{x^2(x+10)} \cdot \frac{(3-x)(3+x)}{(x-3)} \cdot \frac{(x+10)}{(x+4)(x+3)} = \frac{x(x-3)}{x^2(x-3)}$$

$\frac{-1}{x}$

$$5. \frac{2x-1}{x^2-x-2} - \frac{1}{x-2}$$

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

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

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

$$6. \frac{2x}{x+2} - \frac{8}{x^2+2x} + \frac{3}{x}$$

$$\frac{x(2x)}{x(x+2)} - \frac{8}{x(x+2)} + \frac{3(x+2)}{x(x+2)} = \frac{2x^2 - 8 + 3x + 6}{x(x+2)}$$

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

$$7. \frac{x+1}{x} \div \frac{x-1}{x}$$

$$\frac{x+1}{x} \cdot \frac{x}{x-1}$$

$\frac{x+1}{x-1}$

$$8. \frac{2x-2}{3} \div \frac{x+12}{x}$$

$$\frac{2(x-1)}{3} \cdot \frac{x}{x+12} = \frac{2x(x-1)}{3(x+12)}$$

$\frac{2x(x-1)}{3(x+12)}$

$$9. \frac{7x^2}{9x^2-25} - \frac{2}{6x+10}$$

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

$$\frac{14x^2 - 6x + 10}{2(3x-5)(3x+5)} = \frac{2(7x^2 - 3x + 5)}{2(3x-5)(3x+5)}$$

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

$$10. \frac{y}{y-9} + \frac{9}{9-y}$$

$$\frac{y}{y-9} - \frac{9}{y-9} = \frac{y-9}{y-9} = 1$$