

Math-3

Lesson 3-3

Multiplying and Dividing Rational Expressions

Quiz 3-1:

Simplify the following:

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

$$= \frac{4x+8}{x(x+2)} - \frac{-x-6}{(x+2)} = \frac{4x+8}{x(x+2)} - \frac{-x-6}{(x+2)} * \frac{x}{x}$$

$$= \frac{4x+8}{x(x+2)} - \frac{-x^2-6x}{x(x+2)} = \frac{4x+8+x^2+6x}{x(x-2)}$$

$$= \frac{x^2+10x-8}{(x+1)(x-2)}$$

Your Turn: Simplify

1.
$$\frac{x^2 - 3x - 28}{(x + 7)}$$

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

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

BE CAREFUL!!!!!!

$$\frac{x + \cancel{7}}{\cancel{7}(x + 9)}$$

No, no, no, no, no!!!

Addition and Subtraction mean:

Combine the terms into one term (if you can)

If you can't combine them (unlike terms)
they still are connected to each other.

Put binomials into a parentheses.

$$\frac{(x + 7)}{7(x + 9)}$$

Multiplying Fractions

$$\frac{6}{7} * \frac{14}{9} \text{ multiply} = \frac{6*14}{7*9} = \frac{84}{63} \text{ simplify} = \frac{6*14}{7*9}$$

$$= \frac{\cancel{2*3} * \cancel{2*7}}{\cancel{7} * \cancel{3} * 3} = \frac{4}{3}$$

$$\frac{6}{7} * \frac{14}{9} \text{ simplify} = \frac{\cancel{2*3} * \cancel{2*7}}{\cancel{7} * \cancel{3} * 3} = \frac{4}{3}$$

Do you multiply first or do you simplify THEN multiply?

Multiplying Rational Expressions

$$\frac{(x-1)}{2(x+3)} * \frac{x^2-9}{(x+1)} \quad \textbf{\underline{Simplify} before you \underline{multiply}.}$$

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

multiplying allows you to put all the factors together in one numerator and one denominator so you can simplify.

DON'T multiply the simplified version of the product, just leave it in factored form.

Your turn:

Multiply the expressions

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

$$\frac{(x+3)}{(x-5)} * \frac{(x^2-16)}{(x+4)} = \frac{(x+3)(x-4)\cancel{(x+4)}}{(x-5)\cancel{(x+4)}}$$
$$= \frac{(x+3)(x-4)}{(x-5)}$$

Your turn:

Multiply the expressions

(Solutions on this slide)

$$\frac{x^2 + x - 12}{x^2 - 9} * \frac{x^2 - 2x - 15}{x^2 - 16}$$

$$\frac{\cancel{(x-3)}\cancel{(x+4)}}{\cancel{(x-3)}\cancel{(x+3)}} * \frac{\cancel{(x-5)}\cancel{(x+3)}}{\cancel{(x+4)}(x-4)} = \frac{(x-5)}{(x-4)}$$

Your turn:

Multiply the expressions

(Solutions on this slide)

$$\frac{2x^2 - 8x - 24}{x^2 + 2x - 3} * \frac{x^2 + 7x + 12}{x^2 - 2x - 24}$$

$$\frac{2(x^2 - 4x - 12)}{(\cancel{x+3})(x-1)} * \frac{(\cancel{x+3})(\cancel{x+4})}{(x-6)(\cancel{x+4})} = \frac{2(x^2 - 4x - 12)}{(x-1)(x-6)}$$

$$= \frac{2(\cancel{x-6})(x+2)}{(x-1)(\cancel{x-6})} = \frac{2(x+2)}{(x-1)}$$

Divide Rational Expressions

$$\frac{2}{3} \div \frac{5}{7}$$

What do we do?

Multiply by the reciprocal

$$\frac{2}{3} * \frac{7}{5} = \frac{14}{15}$$

Divide Rational Expressions

$$\frac{12xyz}{5mnp} \div \frac{4x^2z}{5mn}$$

Multiply by the reciprocal

$$\frac{\cancel{12}xyz}{\cancel{5}mnp} * \frac{\cancel{5}mn}{\cancel{4}x^2z} = \frac{12xy}{p} * \frac{1}{4x^2} = \frac{\cancel{4} * 3xy}{p} * \frac{1}{\cancel{4} * \cancel{x} * x}$$

$$= \frac{3y}{p} * \frac{1}{x} = \frac{3y}{px}$$

Your turn:

$$\begin{aligned} & \frac{6abz}{7mp^2} \div \frac{4b^3z}{14m^2p} \\ & \frac{6abz}{7mp^2} * \frac{14m^2p}{4b^3z} = \frac{\cancel{2} * 3 * a * \cancel{b}}{\cancel{7} * \cancel{m} * \cancel{p} * p} * \frac{\cancel{2} * \cancel{7} * \cancel{m} * m * \cancel{p}}{\cancel{2} * \cancel{2} * \cancel{b} * b * b} \\ & = \frac{3am}{pb^2} \end{aligned}$$

Dividing Rational Expressions

$$\frac{x+3}{x^2+x-6} \div \frac{x-8}{x-2} = ? = \frac{x+3}{x^2+x-6} * \frac{x-2}{x-8}$$

simplify then multiply!

$$= \frac{x+3}{(x+3)(x-2)} * \frac{x-2}{x-8} = \frac{\cancel{(x+3)}\cancel{(x-2)}}{\cancel{(x+3)}\cancel{(x-2)}(x-8)}$$

$$\frac{1}{(x-8)} \quad \text{OR} \quad (x-8) \quad ?$$

Your turn:

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

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

Your turn:

$$\frac{x^2 + 2x - 35}{x^2 - 4x - 12} \div \frac{x^2 - 2x - 15}{x^2 + 9x + 14}$$

$$\begin{aligned} \frac{x^2 + 2x - 35}{x^2 - 4x - 12} * \frac{x^2 + 9x + 14}{x^2 - 2x - 15} &= \frac{(x+7)\cancel{(x-5)}}{(x-6)\cancel{(x+2)}} * \frac{\cancel{(x+2)}(x+7)}{\cancel{(x-5)}(x+3)} \\ &= \frac{(x+7)(x+7)}{(x-6)(x+3)} \end{aligned}$$

Your Turn:

divide

$$\frac{x^2 - x - 20}{x^2 + 2x - 15} \div \frac{x^2 - 5x + 4}{x^2 + 5x}$$

Divide

$$\frac{28x^2 y^3}{y} \div \frac{14x^2}{6x^3 y^2}$$

Your Turn:

Multiply $\frac{4(x+5)}{4x-16} * \frac{x(x+1)}{2(x+5)}$

Multiply $\frac{x^2-3x-10}{x^2-2x-15} * (x^2+10x+21)$

divide $\frac{x^2-x-2}{x^2+4x-5} \div \frac{2x-4}{5x+25}$

Compound (or Complex) Fraction

$$\frac{\frac{1}{3}}{\frac{2}{5}} = \frac{1}{3} \div \frac{2}{5} = \frac{1}{3} * \frac{5}{2}$$

$$= \frac{1 * 5}{3 * 2} = \frac{5}{6}$$

Simplifying a Compound Rational Function

$$\frac{\frac{2x}{x-1}}{\frac{4x}{x-1}} = \frac{2x}{x-1} * \frac{x-1}{4x} = \frac{2}{4} = \frac{1}{2}$$

Convert division to multiplication

remove common factors in Numerator/denominator

Compound Rational Functions

Convert Division into multiplication

$$\frac{\frac{2x-3}{x-1}}{\frac{x-4}{x-3}} = \frac{2x-3}{x-1} * \frac{x-3}{x-4}$$

Leave as is

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

Simplify

Your turn:

$$\frac{\frac{1}{2x}}{\frac{1}{x^2}}$$

Sum/difference in Numerator and Denominator

1. Combine the numerator fractions into one fraction.

$$\frac{\frac{x}{3} - 6}{2 + \frac{3}{x}} = \frac{\frac{x}{3} - \frac{6}{1}}{2 + \frac{3}{x}} = \frac{\frac{x-18}{3}}{2 + \frac{3}{x}}$$

2. Combine the denominator fractions into one fraction.

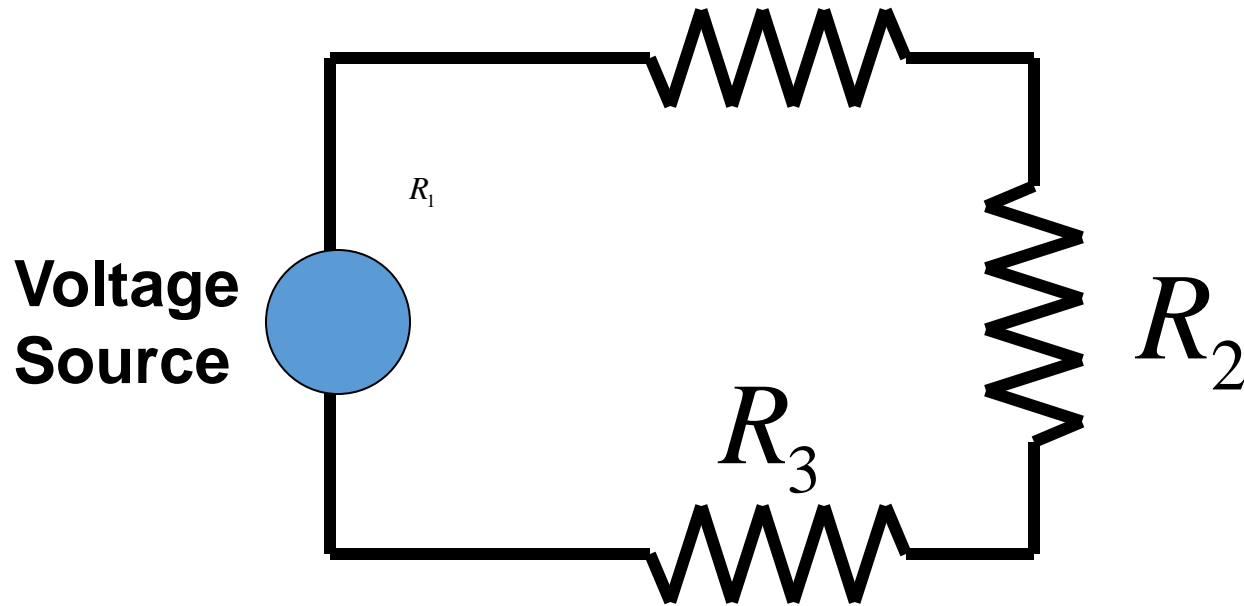
$$\frac{\frac{x-18}{3}}{\frac{2x+3}{x}} = \frac{x-18}{3} * \frac{x}{2x+3} = \frac{x(x-18)}{3(2x+3)}$$

Your turn:

Simplify the complex fraction.

$$\frac{\frac{1}{x} + \frac{2}{3x}}{\frac{3}{x+4}}$$

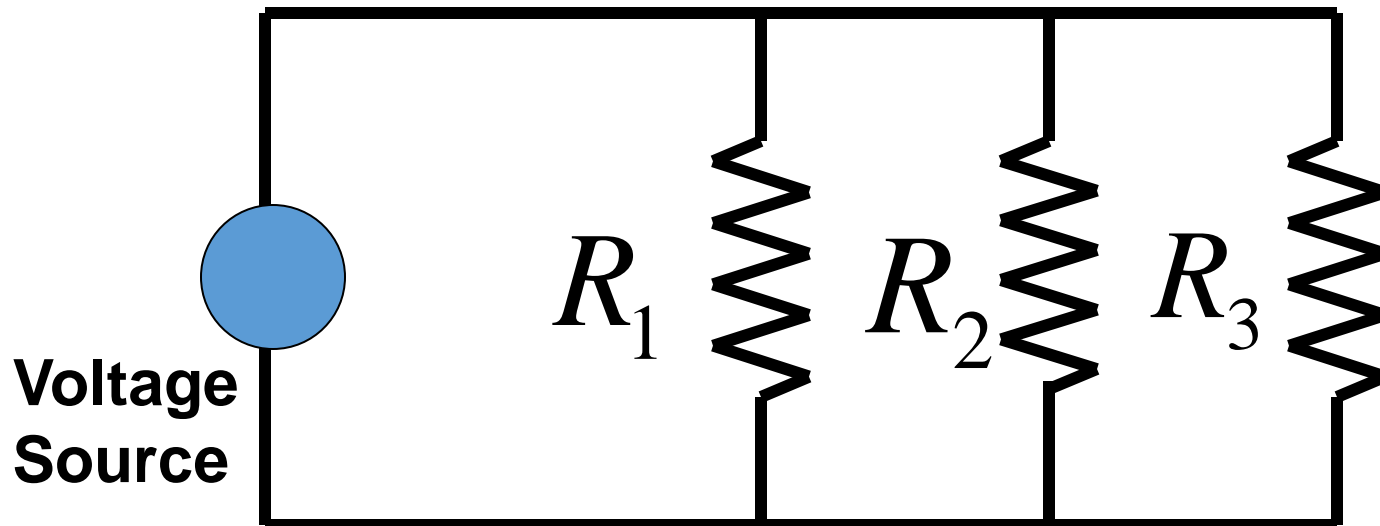
Another Example: Electrical Circuits



$$R_{total} = R_1 + R_2 + R_3$$

Parallel Resistors

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

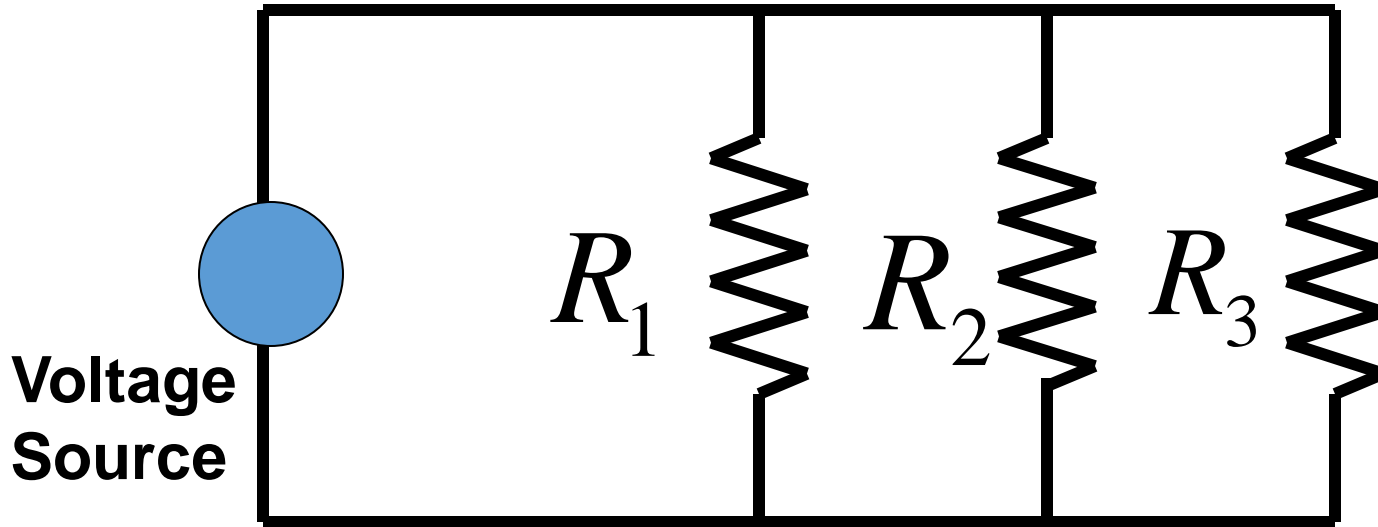


$$\frac{1}{R_T} = \frac{R_2 R_3}{R_1 R_2 R_3} + \frac{R_1 R_3}{R_1 R_2 R_3} + \frac{R_1 R_2}{R_1 R_2 R_3}$$

$$\frac{1}{R_T} = \frac{R_2 R_3 + R_1 R_3 + R_1 R_2}{R_1 R_2 R_3} \quad R_T = \frac{R_1 R_2 R_3}{R_2 R_3 + R_1 R_3 + R_1 R_2}$$

Parallel Resistors

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$



Electrical resistance is measured in “ohms.” Given the following resistances, find the total resistance of the circuit. $R_1 = 5 \Omega$ $R_2 = 10 \Omega$ $R_3 = 15 \Omega$

$$R_T = \frac{R_1 R_2 R_3}{R_2 R_3 + R_1 R_3 + R_1 R_2} = \frac{5 * 10 * 15}{(10 * 15) + (5 * 15) + (5 * 10)} = 2.72 \Omega$$

People working together is similar to parallel resistance because they are working “in parallel”.

The total time to complete a job is a function of the times required to complete the job by each worker separately. $\frac{1}{T_t} = \frac{1}{T_a} + \frac{1}{T_b}$

Alfonso takes 5 hours to paint a room. Bob takes 6 hours to paint the same room. How long does it take them to paint the room while working together?

$$\frac{1}{T_t} = \frac{1}{5} + \frac{1}{6}$$

$$\frac{1}{T_t} = \frac{6}{30} + \frac{5}{30}$$

$$\frac{1}{T_t} = \frac{11}{30}$$

$$T_t = \frac{30}{11} = 2.7 \text{ hrs}$$