

Intro to college math: Chapter 7.1
Simplifying Rational Expressions

- * Rational expression — any expression that can be put in form $\frac{p}{Q}$, where Q is $\neq 0$.
- * Simplifying a rational expression — to simplify a rational expression, first factor the numerator and denominator completely and then divide both the numerator and denominator by any factors they have in common.

1. Simplify. $\frac{3c-18}{4c-24}$

$\frac{3c-18}{4c-24} = \frac{3(\cancel{c-6})}{4(\cancel{c-6})} = \boxed{\frac{3}{4}}$

← cancel out what top + bottom have in common

- * 1st Look at numerator (top) and factor out what it has in common.
- * 2nd Look at denominator (bottom) and factor out what it has in common.
- * Then cancel out what the top + bottom have in common.
- * Write down what's left.

Reminder: To factor:

$3c-18$ ← Think what both terms have in common

3 ← They both can be divided by a 3 evenly.

$3(\)$ ← Write that number on the outside of the ()

$\frac{\cancel{3}c-18}{\cancel{3}} \frac{3}{3}$ ← now think about each original term divided by the term outside the ().

$3(c-6)$ ← write down inside the () what you get after you divide.

2. Reduce the rational expression to lowest terms. If it is already in lowest terms, enter the expression in the answer box.

$$\frac{12y-24}{11y-22}$$

$$\frac{12y-24}{11y-22} = \frac{12(\cancel{y-2})}{11(\cancel{y-2})} = \boxed{\frac{12}{11}}$$

- * 1st Look at numerator (top) and factor out what it has in common.
- * 2nd Look at denominator (bottom) and factor out what it has in common.
- * Then cancel out what the top + down have in common.
- * Write down what's left.

3. Reduce the rational expression to lowest terms. If it is already in lowest terms, enter the expression in the answer box.

$$\frac{2a^2-32}{2a+8}$$

$$\frac{2a^2-32}{2a+8} = \frac{2(a^2-16)}{2(a+4)} = \frac{\cancel{2}(\cancel{a+4})(a-4)}{\cancel{2}(\cancel{a+4})} = \boxed{a-4}$$

- * First look at numerator and factor out what the terms have in common.
- * Then, look at denominator and factor out what the terms have in common.
- * On the top in the (), you have something squared minus something squared. So.... you make 2 sets of ()(), place a variable in each one, then a (+) in one and a (-) in another. Then right down the square root of the number in each one.

4. Reduce the rational expression to lowest terms. If it is already in lowest terms, enter the expression in the answer box.

$$\frac{5a-3}{25a^2-9}$$

$$\frac{5a-3}{25a^2-9} = \frac{5a-3}{(5a+3)(5a-3)} = \frac{1}{(5a+3)}$$

Handwritten work shows the factoring of the denominator: $\sqrt{25a^2} = 5a$ and $\sqrt{9} = 3$. Arrows indicate the cancellation of the common factor $(5a-3)$ between the numerator and denominator.

* First look at numerator and factor out what the terms have in common, if able

* On the bottom, take the $\sqrt{\quad}$ of each term. Then make 2 sets of $(\quad)(\quad)$. Place the $\sqrt{\quad}$ of each term in the $(\quad)(\quad)$, separated by $+$ in one and $-$ in other.

5. Simplify the following expression completely.

$$\frac{9k-63}{k^2+3k-70}$$

$$\frac{9k-63}{k^2+3k-70} = \frac{9(k-7)}{(k-7)(k+10)} = \frac{9}{k+10}$$

Handwritten work shows the factoring of the denominator using the AC method. The constant term 70 is broken down into pairs: $1 \cdot 70$, $2 \cdot 35$, $5 \cdot 14$, and $7 \cdot 10$. The pair $7 \cdot 10$ is circled, and arrows indicate its use to split the middle term $3k$ into $7k$ and $10k$, leading to the factored form $(k-7)(k+10)$.

* First factor out what terms on top have in common

* On bottom of fraction, you will factor. Write the last number down to the side and list all the numbers that can multiply together to get that number. Then circle the pair that add or subtract to get the middle number, and place them in the $(\quad)$.

5. Reduce the rational expression to lowest terms. If it is already in lowest terms, enter the expression in the answer box.

$$\frac{3y-3}{3y^2+6y-9}$$

$$\frac{3y-3}{3y^2+6y-9} = \frac{3(y-1)}{3(y^2+2y-3)} = \frac{\cancel{3}(y-1)}{\cancel{3}(y-1)(y+3)} = \boxed{\frac{1}{y+3}}$$

$(y-1)(y+3)$ with a red arrow pointing to a red '3' above it, which is circled in red with '1 · 3' written below it.

* First factor out what terms on top have in common

* On bottom of fraction, you will factor. Write the last number down to the side and list all the numbers that can multiply together to get that number. Then circle the pair that add or subtract to get the middle number, and place them in the ().

6. Simplify the expression.

$$\frac{x^2+10x+24}{x^2+5x+4}$$

$$\frac{x^2+10x+24}{x^2+5x+4} = \frac{(x+4)(x+6)}{(x+1)(x+4)} = \boxed{\frac{x+6}{x+1}}$$

For the numerator $x^2+10x+24$, the number 24 is written to the right. Below it, a list of factor pairs is shown: 1 · 24, 2 · 12, 3 · 8, and 4 · 6. The pair 4 · 6 is circled in red. A red arrow points from the 24 to this list.

For the denominator x^2+5x+4 , the number 4 is written to the right. Below it, a list of factor pairs is shown: 1 · 4 and 2 · 2. The pair 1 · 4 is circled in red. A red arrow points from the 4 to this list.

Purple arrows connect the circled pairs (4 · 6) and (1 · 4) to the corresponding factors in the factored form of the fraction.

* On both the top + bottom:

Write the last number

down to the side and list all the numbers that can multiply together to get that number. Then circle the pair that add or subtract to get the middle number. Then make 2 sets of () and place the variable + pairs on numbers in each one.

7. Simplify the expression. $\frac{z^2 - 3z - 10}{z^2 + 9z + 20}$

$$\frac{z^2 - 3z - 10}{z^2 + 9z + 20} = \frac{(z+2)(z-5)}{(z+4)(z+5)}$$

Handwritten work for factoring the numerator and denominator:

Numerator: $z^2 - 3z - 10$
 Factors of -10: $1 \cdot 10$, $2 \cdot 5$ (circled).
 Factors of -10 that add to -3: $2 \cdot 5$ (circled).

Denominator: $z^2 + 9z + 20$
 Factors of 20: $1 \cdot 20$, $2 \cdot 10$, $4 \cdot 5$ (circled).
 Factors of 20 that add to 9: $4 \cdot 5$ (circled).

* On both the top + bottom:

Write the last number

down to the side and list all the numbers that can multiply together to get that number. Then circle the pair that add or subtract to get the middle number. Then make 2 sets of $(\quad)$ and place the variable + pairs on numbers in each one.