# Steps Maths.

**Equations & Fractions.**

# ALGEBRAIC FRACTIONS

Operations involving algebraic fractions can be done just like operations involving normal fractions with different denominators

## ADDITION AND SUBTRACTION

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**Adding and Subtracting Algebraic Fractions**

**STEP 1:** Identify the lowest common denominator of the denominators of all the fractions

**STEP 2:** Multiply the top and bottom of each fraction so that each denominator is the lowest common denominator

**STEP 3:** Combine the fractions over one denominator and simplify

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**Question 1**

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

**STEP 1:** Identify the lowest common denominator of the denominators of all the fractions

**STEP 2:** Multiply the top and bottom of each fraction so that each denominator is the lowest common denominator

**STEP 3:** Combine the fractions over one denominator and simplify

**Question 2**

Simplify $\dfrac{1}{x-2} - \dfrac{2x}{x+2}$

**STEP 1:** Identify the lowest common denominator of the denominators of all the fractions

**STEP 2:** Multiply the top and bottom of each fraction so that each denominator is the lowest common denominator

**STEP 3:** Combine the fractions over one denominator and simplify

**Question 3**

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

**STEP 1:** Identify the lowest common denominator of the denominators of all the fractions

**STEP 2:** Multiply the top and bottom of each fraction so that each denominator is the lowest common denominator

**STEP 3:** Combine the fractions over one denominator and simplify

## MULTIPLICATION AND DIVISION

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**Multiplying and Dividing Algebraic Fractions**

**STEP 1:** If a fraction is being divided, flip the fraction and turn it into a multiplication

**STEP 2:** Factorise all expressions and cancel out any common factors between the numerators and denominators

**STEP 3:** Multiply the remaining terms together into one fraction and simplify

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**Question 4**

Simplify $\frac{x^2-3x}{x+1} \div \frac{x}{x^2-1}$

**STEP 1:** If there is a division, flip the fraction and turn it into a multiplication

**STEP 2:** Factorise all expressions and cancel out any common factors between the numerators and denominators

**STEP 3:** Multiply the remaining terms together into one fraction and simplify

**Question 5**

Simplify $\frac{x^3-4x}{xy-2y} \times \frac{y}{x+2}$

**STEP 1:** If there is a division, flip the fraction and turn it into a multiplication

**STEP 2:** Factorise all expressions and cancel out any common factors between the numerators and denominators

**STEP 3:** Multiply the remaining terms together into one fraction and simplify

**Question 6**

Simplify $\dfrac{3x-x^2}{3y-xy+12-4x} \div \dfrac{x}{y^2+3y}$

**STEP 1:** If there is a division, flip the fraction and turn it into a multiplication

**STEP 2:** Factorise all expressions and cancel out any common factors between the numerators and denominators

**STEP 3:** Multiply the remaining terms together into one fraction and simplify

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**Question 7**

Simplify the following algebraic fractions

a)   $\dfrac{2}{x} - \dfrac{3x}{x+2}$

b)   $\dfrac{1}{x^2-1} + \dfrac{2x}{x-1}$

c)   $\dfrac{1}{x-2} + \dfrac{x^2-5x}{(x-2)(x-4)} \div \dfrac{x-5}{x^2-4x}$

## SIMPLIFYING COMPOUND FRACTIONS

> **Compound Fractions**
>
> If the fraction contains a compound fraction, first multiply the top and bottom by the denominator of the compound fraction, and then simplify the fraction as normal

**Question 8**

Consider the fraction $\dfrac{3-\frac{1}{x}}{1-3x}$

a) Multiply the fraction by $\dfrac{x}{x}$

b) Hence, simplify $\dfrac{3-\frac{1}{x}}{1-3x}$

## Question 9

Simplify the following compound fractions

a)   $\dfrac{\frac{1}{x}+4}{x+2}$

b)   $\dfrac{\frac{1}{x+3}+2}{x-3}$

c)   $\dfrac{\frac{x^2}{x^2+1}-1}{x}$

# SIMULTANEOUS EQUATIONS

Some equations contain more than one variable, and cannot be solved with one equation alone. To solve these, you must make use of more than one equation

## SOLVING BY SUBSTITUTION

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**Solving by Substitution**

**STEP 1:** Using one equation, make $x$ or $y$ the subject

**STEP 2:** Substitute this into the second equation and solve for one variable

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

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*Talent Tip:*

**Question 9**

Find $x$ and $y$, given that

$$2x + y = 7$$
$$x + 2y = 5$$

**STEP 1:** Using one equation, make $x$ or $y$ the subject

**STEP 2:** Substitute this into the second equation and solve for one variable

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

**Question 10**

Find $x$ and $y$, given that

$$x - 4y = -14$$
$$3x + 2y = 0$$

**STEP 1:** Using one equation, make $x$ or $y$ the subject

**STEP 2:** Substitute this into the second equation and solve for one variable

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

**Question 11**

Find $x$ and $y$, given that

$$3x + 4y = 11$$
$$x - 3y = 8$$

**STEP 1:** Using one equation, make $x$ or $y$ the subject

**STEP 2:** Substitute this into the second equation and solve for one variable

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

**Question 12**

Solve the following equations by substitution

a)   $x - y = -3$ and $3x + 2y = -1$

b)   $4x + 2y = 3$ and $x + y = -1$

## SOLVING BY ELIMINATION

**Solving by Elimination**

**STEP 1:** Multiply one or both equations by a constant so that the $x$ or $y$ terms in each equation are identical in number

**STEP 2:** Add or subtract the equations from each other to eliminate $x$ or $y$, and solve

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

*Talent Tip:*

**Question 15**

Find $x$ and $y$, given that

$$2x + y = 5$$
$$x + 2y = 4$$

**STEP 1:** Multiply one or both equations by a constant so that the $x$ or $y$ terms in each equation are identical in number

**STEP 2:** Add or subtract the equations from each other to eliminate $x$ or $y$, and solve

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

**Question 16**

Find $x$ and $y$, given that

$$3x - 5y = -29$$
$$2x + 4y = 10$$

**STEP 1:** Multiply one or both equations by a constant so that the $x$ or $y$ terms in each equation are identical in number

**STEP 2:** Add or subtract the equations from each other to eliminate $x$ or $y$, and solve

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

**Question 17**

Find $x$ and $y$, given that

$$5x - 6y = 23$$
$$2x + 3y = -7$$

**STEP 1:** Multiply one or both equations by a constant so that the $x$ or $y$ terms in each equation are identical in number

**STEP 2:** Add or subtract the equations from each other to eliminate $x$ or $y$, and solve

**STEP 3:** Substitute what you get for **STEP 2** into one of the original equations and solve the other variable

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**Question 18**

Solve the following equations by elimination

a)  $3x - 2y = 16$ and $4x + y = 14$

b)  $2x - 5y = 4$ and $3x + 4y = -17$

**Question 19**

$x$ and $y$ are two numbers such that

$$x^2 - y = 3$$

$$3x^2 - 2y = 10$$

Find $x$ and $y$ using

a) Substitution

b) Elimination