Reviewing one step equations in one variable

$x+1=3$

$x=3-1$

$x+n=a$

$x=a-n$

$x-1=2$

$x=2+1$

$x-n=a$

$x=a+n$

$2x=3$

$x=\frac{3}{2}$

$nx=a$

$x=\frac{a}{n}$

$\frac{x}{5}=2$

$x=2\cdot 5$

$\frac{x}{n}=a$

$x=a\cdot n$

$x+n=a$

$x=a-n$

$x-n=a$

$x=a+n$

$nx=a$

$x=\frac{a}{n}$

$\frac{x}{n}=a$

$x=a\cdot n$

Expression

$x+1$

$2x$

$2x+1$

$3(2x+1)$

Equation has an equal sign so one side equals the other side

$$3(2x+1)=9$$

$$2x+1=3$$

$$2x=2$$

$$x=1$$

When we do multiple operations, we want to have consistency to know what order to do the operations in. We follow an order of operations that we can remember with PEMA

Parentheses

Exponents

Multiplication/division

Addition/subtraction

Remember that for just addition, or just multiplication, the order doesn’t matter. It is when we combine the operations that we have to pay attention to the order.

Parentheses

Exponents

Multiplication/division

Addition/subtraction

Parentheses can be used to go out of the order of PEMA.

$2(1+2)$ means do the addition first and then multiply $2(x+1)$

$(1+2)^2$ means do the addition first and then do the exponent.

Parentheses are used to group for order.

$x+1$ I add 1 to x

$2x$ I multiply x times 2

$2x+1$ First I multiply the x times 2, then I add 1 to that

But what if I want to add the one first and then double it?

I use parentheses to show that I add the one first, and then I double it after:

$2(x+1)$

Evaluate an expression

Expressions are wrapping up the input.

$10(2x+1)+5$

$10(2(1)+1)+5$

We evaluate an expression by putting in a number for the variable.

To evaluate an expression, start at the variable or the inner most parentheses and work out in order as written and following the rules of order.

2*1 then add 1 then multiply by 10 then add 5 to get 35

$10(2(1)+1)+5=35$

Evaluating for x is 1 by hand

2*1 then add 1 then multiply by 10 then add 5

$$10(2x+1)+5$$

$$(1)$$

$$2 \quad +1$$

$$10 \cdot \quad 3$$

$$30 \quad +5$$

$$35$$

$$30 \quad +5 = 35$$

$$3$$

$$2$$

$$10(2 \cdot 1+1)+5$$

Working memory is the clipboard for the memory that you are using.

[How to Optimize Working Memory in the Classroom | Edutopia]

Write out as much as you need to when you are solving a problem. Some you may be able to do in your head and some you will want to write out each step. It will depend on the situation and the problem.

You can also write out each step incase you have to go back and fix mistakes, show someone else what you did, or be able to come back and finish after an interruption.

Evaluate an expression

To evaluate for x is -1, plug in or substitute -1 for x

$10(2x+1)+5$

$10(2(-1)+1)+5$

$10(-2+1)+5$

$10(-1)+5$

$-10 +5$

-5

$f(x) = 10(2x+1)+5$

$f(-1) = -5$

Using function notation to track what we use to evaluate an expression.

Function with input x equals the output or the formula for the output.

$f(x) = 10(2x+1)+5$

$f(1) = 35$

$f(0) = 15$

$f(-1) = -5$

$f(a) = 10(2a+1)+5$

The last example just changes the variable, like changing a chocolate chip cookie recipe to be raisins instead of the chocolate chips.

An expression is a formula. You can simplify an expression, but you can't "solve" it.

$2x+1$

$f(x)=2x+1$

I don't have enough information to say what number this equals.

I would need to know what x is in order to evaluate it or say what the output is.

$f(x)=2x+1$

$f(1)= 2(1)+1=3$

$f(-5)= 2(-5)+1= -10+1= -9$

Simplifying expressions

$2x+1+2$

$2x+3$

$2x+1+3x+2$

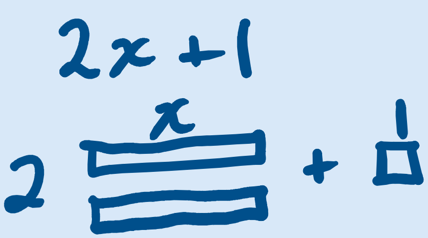
$5x+3$

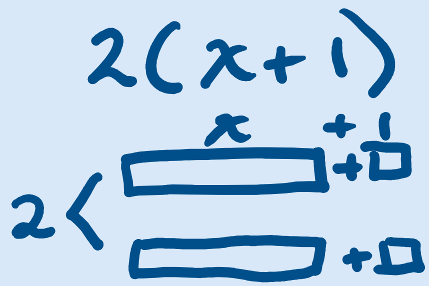
$2(x+1)+1$

2x+1 and 2(x+1) are different!

2(3)+1=7 2(3+1)=8

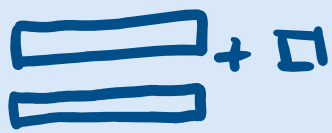
Plugging in 1 for x: 2(1)+1 is 3 but 2(1+1) is 2(2) is 4.



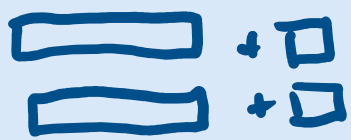


$2x+1$ and $2(x+1)$ are different!

$2x+1$



$2(x+1)$



Expressions that equal each other are called **equivalent** expressions.

$2(x+1) = 2x+2$

$10(x+3) =$

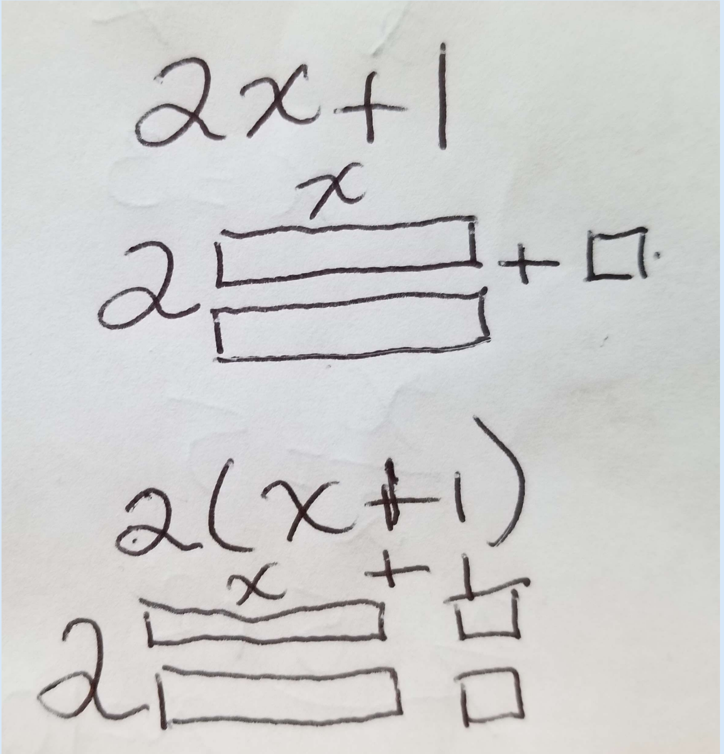
$2(x+5) = 2x+10$

$2x+2 \cdot 5$

The expressions on the left and on the right of each line are equivalent.

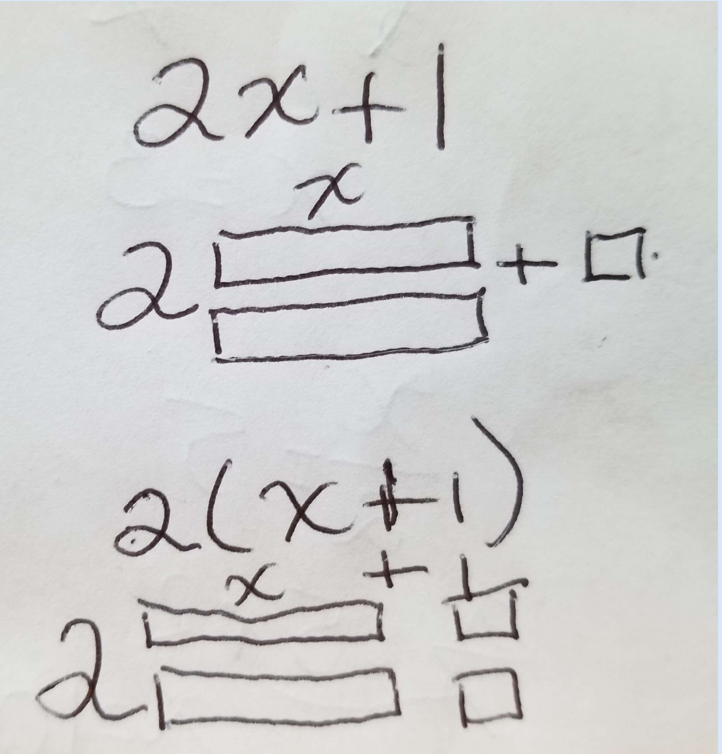
Distributive property of multiplication over addition.

If you have just numbers, you add the numbers in the parentheses first and then multiply.
But what if you have a variable in the parentheses? That is when you can expand it using distribution.



We use the distribution of multiplication over addition all the time! $3(f+k+s)=3f+3k+3s$

Visualizing distribution with algebra tiles



With rainbows or arcs

$$2(x+1) = 2x+2$$

Lined up method

$$\begin{array}{r} x+1 \\ 2 \\ \hline 2x+2 \end{array}$$

Line-up method for long problems

$$
\begin{array}{rrrrr}
 & x^2 & +2x & +1 & \\
\cdot & & & x & +10 \\
\hline
 & 10x^2 & +20x & +10 & \\
+\ x^3 & +2x^2 & +x & & \\
\hline
x^3 & +12x^2 & +21x & +10 &
\end{array}
$$

This can be used with powers of ten instead of x.

$$\begin{array}{r} 231 \\ \cdot \quad 21 \\ \hline 231 \\ + \; 462 \\ \hline 4\,8\,\bar{5}\,1 \end{array}$$

Remember that x is 1x and x times x is x^2.

$$x(x+1)$$

$$x^2 + x$$

$$\begin{array}{r} x+1 \\ x \\ \hline x^2+x \end{array}$$

Box method

	x	$+ 1$
2	$2x$	2

$2x + 2$

Box method is good for binomial multiplication

(x+1)(x+2)

	x	$+1$
x	x^2	x
$+2$	$2x$	2

x^2+3x+2

Each term has to get multiplied by each term.

$$(x+1)(x+2)$$

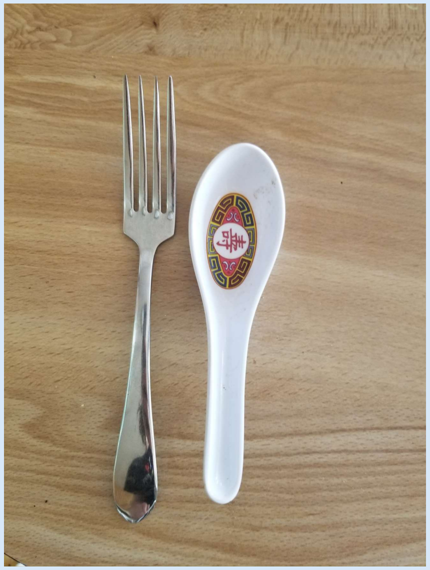
$$(a+b)(c+d)$$

If you are having trouble with this, place settings are a good example and way of practicing.

$2\ f + 1s$

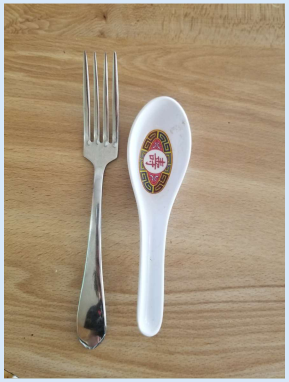
$2\ (\ 1f + 1s\ )$

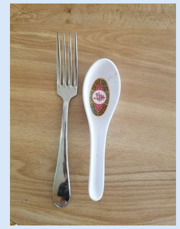
$2\ f + 2\ s$

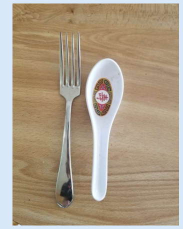


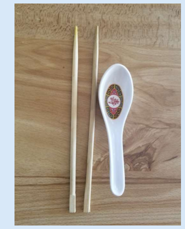
If 2 people want a fork and spoon, and 3 people want 2 (a pair of) chopsticks, then how many of each do we have to get out of the drawer?

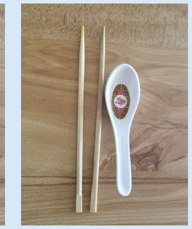
$$2(f+sp) + 3(2ch + sp)$$







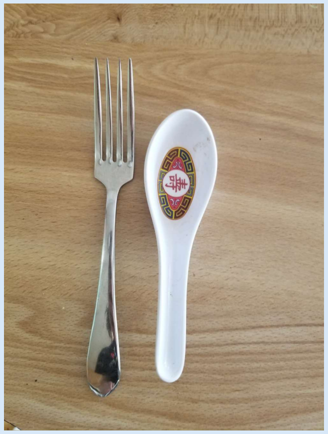
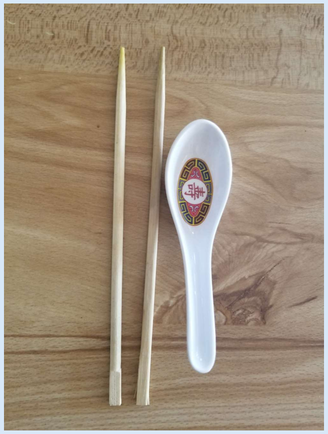




$$2(f+sp)+3(2ch+sp)$$

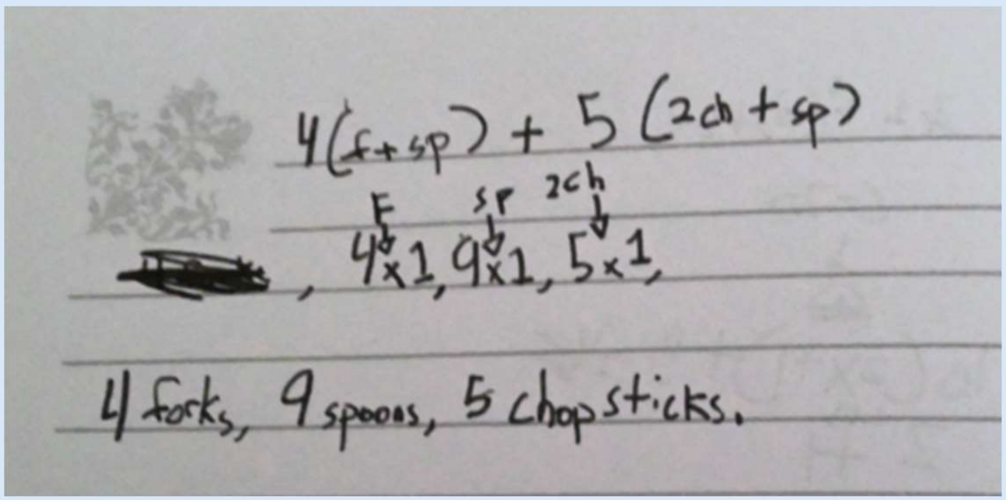
$$2f+2sp+3\cdot 2ch+3sp$$

$$2f+6ch+5sp$$

$4(f+sp) + 5(2ch + sp)$

$4(f{+}sp) + 5(2ch + sp)$


$4(f+sp) + 5(2ch+sp)$

F sp 2ch

[redacted], 4×1, 9×1, 5×1,

4 forks, 9 spoons, 5 chopsticks.

For now, we are doing linear expressions with one variable, so just numbers times one variable.

2(x+1)   +1
 2x+2   +1
  2x+3

2(x+1)   3(x+2)
 2x+2*1   3x+3*2 =3x+6

2(5x-3)   10(2x-3)
 2*5x - 2*3   10*2x – 10*3

It doesn't matter if the variable is neg, pos, rational or irrational, distribution still works.

2(x+1) = 2x+2

2(1+1) = 2(1)+2 = 4

2((-1)+1)= 2(-1)+2 = 0

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

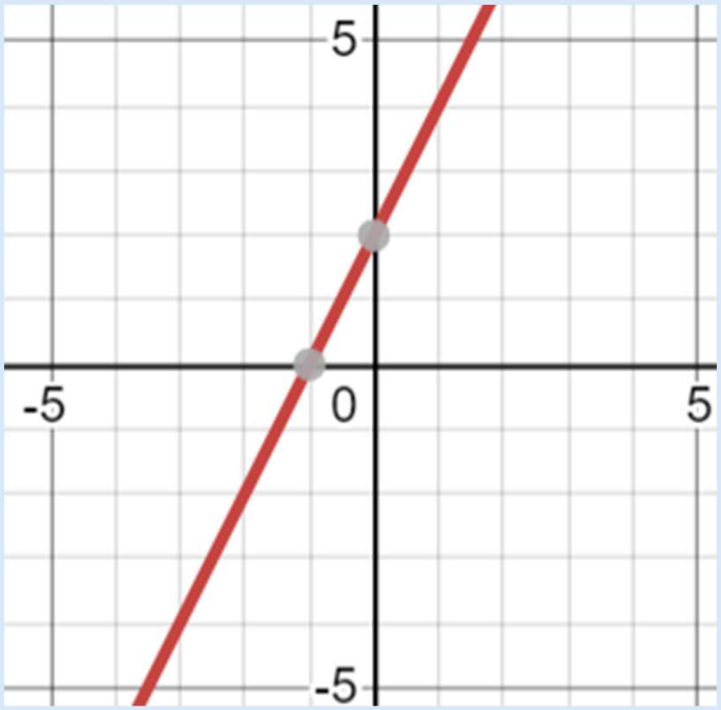
$2(\frac{3}{2}) = 1 + 2$

2(e+1) = 2e+2≈ 2(3.7)=2(2.7)+2

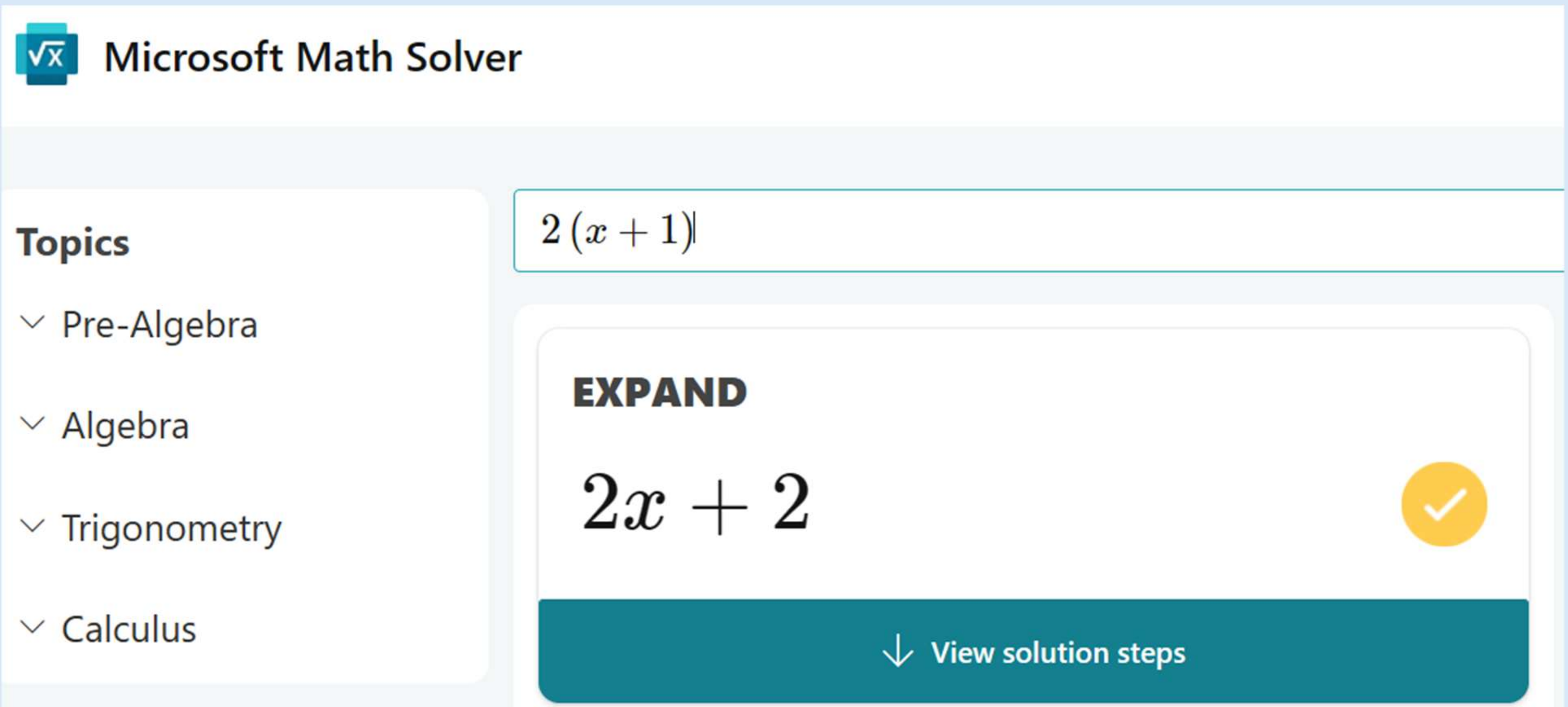
7.4 = 5.4+2

Desmos | Graphing Calculator does it for you

$y=2(x+1) = 2x+2$



Microsoft Math will also do it for you.



Remember about multiplying by negative numbers.

-2(x+1) is -2x-2

-2(x-1) is -2x+2   -2(x-1) is 2(-x+1) is 2(1-x)

-2(-x-1) is 2(x+1)   is 2x+2

When I have a negative number that I am distributing, I change the signs first, so I don't forget or get confused. If writing by hand, when I see the negative sign, I leave extra room after the parentheses.

Remember about multiplying by negative numbers.

-2(-x-1)

2x+2

is 2(x+1)   is 2x+2

Remember about invisible numbers

-(x+2) is the same as (-1)*(x+2) =-x -2

-(x-2) don’t forget that a negative times a negative is a positive!

-x +2

Division also distributes over addition and subtraction

Remember that the division bar acts as a grouping symbol. Add parentheses if that helps you remember!

$$\frac{x}{2} + 1 \qquad \frac{x+1}{2}$$

These are different expressions!

Substituting (or plugging in) a 1 for x to show these are different expressions

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

$$\frac{1}{2}+1$$

$$\frac{3}{2} \text{ or } 1\tfrac{1}{2} \text{ or } 1.5$$

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

$$\frac{1+1}{2}$$

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

Multiply on top and divide on the bottom

$\frac{x}{5} = (\frac{1}{5})\,x$

$\frac{x+1}{5} = \frac{1}{5}(x+1) = \frac{x}{5} + \frac{1}{5}$

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

Division also distributes

$\frac{1+2}{3} = \frac{3}{3} = 1$ $\frac{1}{3} + \frac{2}{3} = \frac{3}{3} = 1$

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

$\frac{ax+b}{c} = \frac{ax}{c} + \frac{b}{c}$ $c \neq 0$ $\frac{ax}{c} + \frac{b}{c}$

$\frac{ax+b}{cd} = \frac{ax}{cd} + \frac{b}{cd}$ $c \neq 0, d \neq 0$

Can not have zero in the bottom

$$\frac{ax+b}{c} = \frac{ax}{c} + \frac{b}{c} \quad c\neq 0 \qquad \frac{ax}{c} + \frac{b}{c}$$

$$\frac{ax+b}{cd} = \frac{ax}{cd} + \frac{b}{cd} \quad c\neq 0,\ d\neq 0$$

$$\frac{ax+b}{c+d} = \frac{ax}{c+d} + \frac{b}{c+d} \quad c+d\neq 0$$

We are still talking about linear expressions so x can not be in the denominator!