

# Setting out equations in Splash!



***Access to Shape, Drawing and Number***

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## What is this guide?

This guide explains how the student can use the Equation writing tool in Splash to set out equations. It is for both users who mostly use pointer-based input and those using only the keyboard as there is some crossover between the methods.

The equations tool is used predominantly in Maths, but does fully support chemical equations, for example.

## About the equation editor

This can be used to write anything from very simple equations up to complex university-level maths:

$$x+y=1$$

$$\frac{[\Gamma(x)]^2}{\Gamma(2x)} = \frac{1}{2} \int_0^1 \tau^{x-1} (1-\tau)^{x-1} d\tau = \frac{\Gamma(x)\Gamma(x)}{\Gamma(2x)}$$

The editor is fully WYSIWYG (what-you-see-is-what-you-get) – ie you type directly into the equation and see what it looks like as you type. The equation doesn't need to be entered as a series of commands elsewhere, which is used in some Maths software. It works just like typing normal text, but can cope with the 2D-layout needed for equations.

## Getting started

The equation tool is mainly used in the various Equation activities, although it does appear in one or two others, sometimes with reduced options. So select "Equations" (KS2 users), or "Maths Equations" (KS3-5 users) from the user's menu page to start.

These workspaces do also contain some limited graphical tools, such as lines and rectangles, and plain text. For the equation itself select the Equation tool (Shift + Q  $\Sigma$ q from the keyboard).

Then just click on the page and start typing – much like with the text tools.

## Pointer users

Pointer users will need an on-screen keyboard, including at least the numbers and arrow keys, and almost certainly the usual alphabet. Splash provides all the mathematical symbols – the intention is that the student can use the same on-screen keyboard they use for most software.

A pointer-based method of selecting mathematical symbols is described below, which is typically used by pointer-based users. However the text entry method may also work well, as the text codes potentially only need a few key strokes, especially for the most cognitively able students and/or on smaller screens.

## Keyboard users

Keyboard users can type basic content as normal. Splash provides codes which allow all the mathematical content to be inserted.

## Basic editing

Basic content is typed as with a text tool.

The typing point can be moved by clicking at a new position within the equation, or using the arrow keys. Note that all four arrows keys are important – up and down can play a big role. (See also p14)

An area can be selected by clicking and dragging, or by using Shift + Arrow key, although typically you don't need to do this very often.

## Typing position

The typing point is indicated by a flashing caret as normal. In addition a purple dotted border is used to indicate when you are typing inside any container element (brackets, divisor, root, integral, matrix etc). This is useful because with equations there can be sometimes a number of locations very close together into which you can type.

For example:

In the first the typing is currently just inside the top bracket.

Pressing the right arrow stepped outside the bracket, but is still in the top half of the divisor, as in the second image – hence the purple border is now around the entire divisor.

Pressing the right arrow again now steps outside the divisor typing to the right of it.

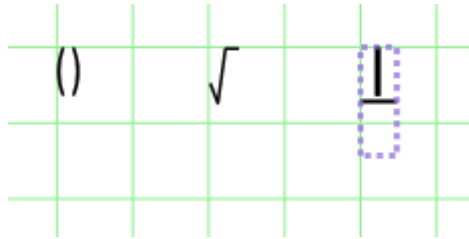
These images show the result if "+ z" was typed in each case:

Or, for example, this can distinguish between typing inside a square root symbol:

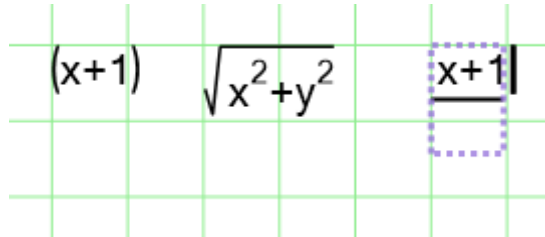
or outside of it:

## Container items

A number of parts of an equation act as containers into which other content is inserted. For all of these it is best to add the container first (details below):

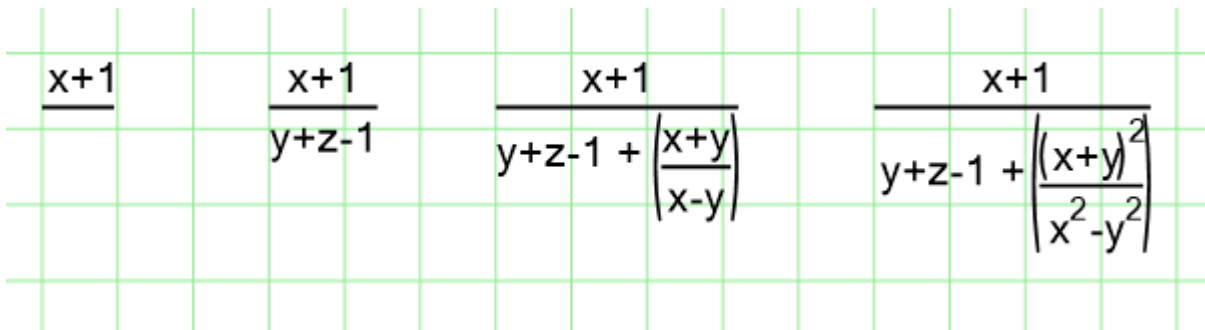


This will then place the typing cursor inside, and you can start typing the content:



In the case of the divisor, on the right, the down arrow is used to move into the bottom half.

All containers will automatically expand both horizontally and vertically as needed, depending on the content:



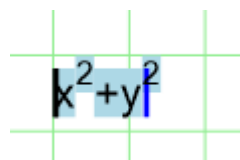
The initial horizontal divisor line has steadily extended, to match the increasing amount of text in the denominator.

## Retrofitting the container

Although it's better to create the container element first, it is possible to add it afterwards if needed. For example if you want to add the root like this:



you can do so by selecting the range the root is to go around first so that it is all highlighted:

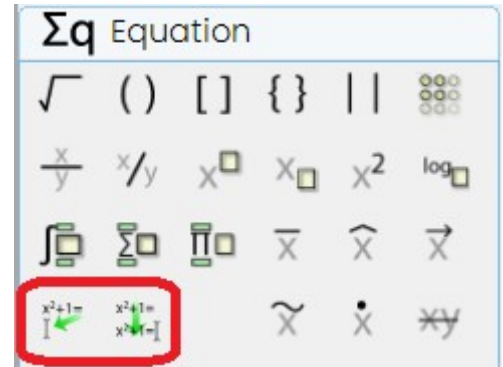


## Subsequent lines/equations

In Maths the student will often want to continue a second equation below the first, quite likely with much of the same content somewhat rearranged.

Splash has options 2 options to start a follow up equation – one starting blank, and one starting with a copy of the current equation. For pointer users these appear on the main Equations palette.

For keyboard users, the Enter key starts a new blank line beneath the current one. Shift + Enter starts with a copy of the current line.



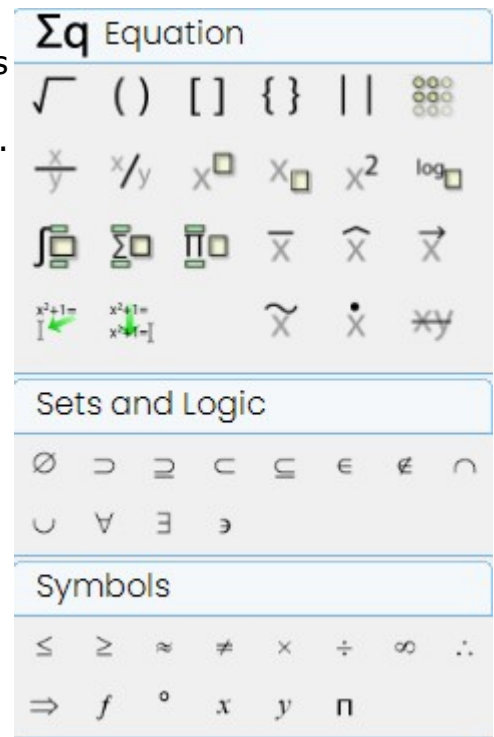


## Adding content - pointer style

For pointer users Splash displays a number of palettes on the right-hand side of the screen with all the various items which can be added. The exact set of palettes depends on which activity was selected from the user's main menu.

These contain both single symbols (eg most of the *Sets and Logic* and *Symbols* palettes) and the container items such as roots and divisors.

As with all the Palettes in Splash these can be moved around the screen, and can float free or be docked or undocked – they usually start docked on the right. See the manual for Pointer users for more details.

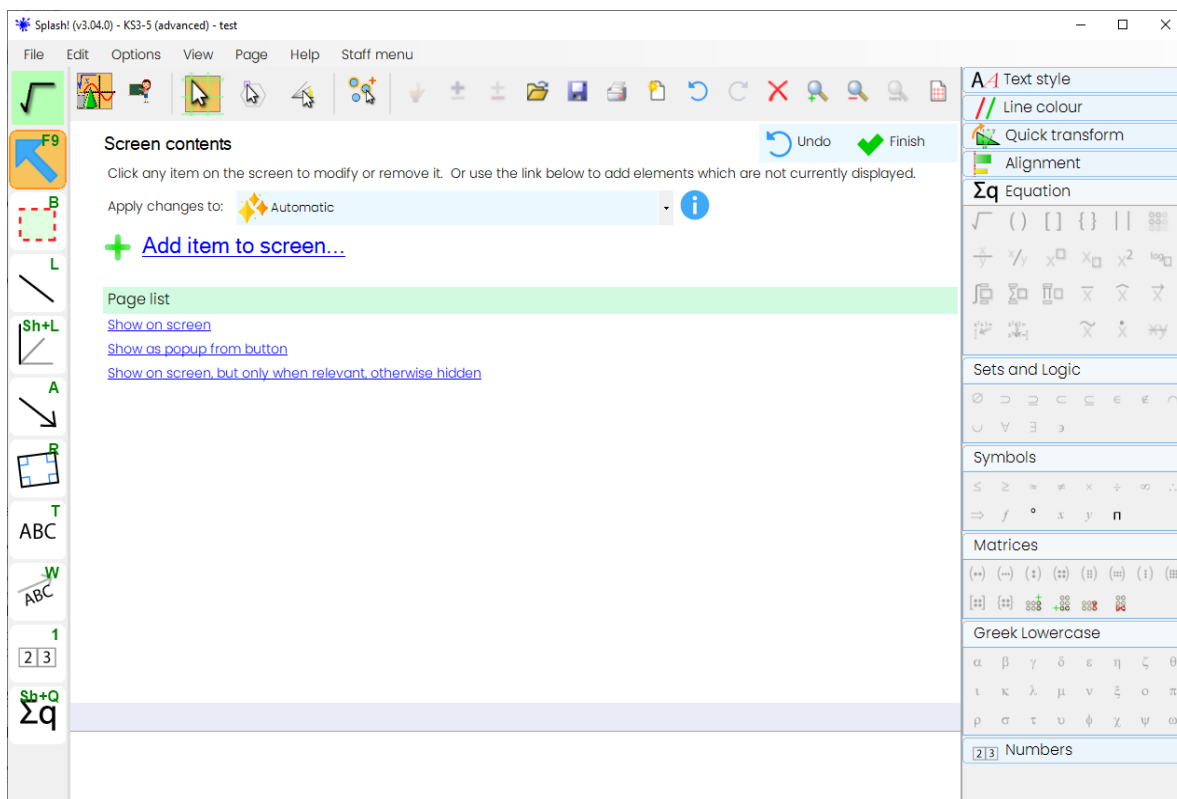


## Changing the palette selection

It is also possible to change which palettes are displayed.

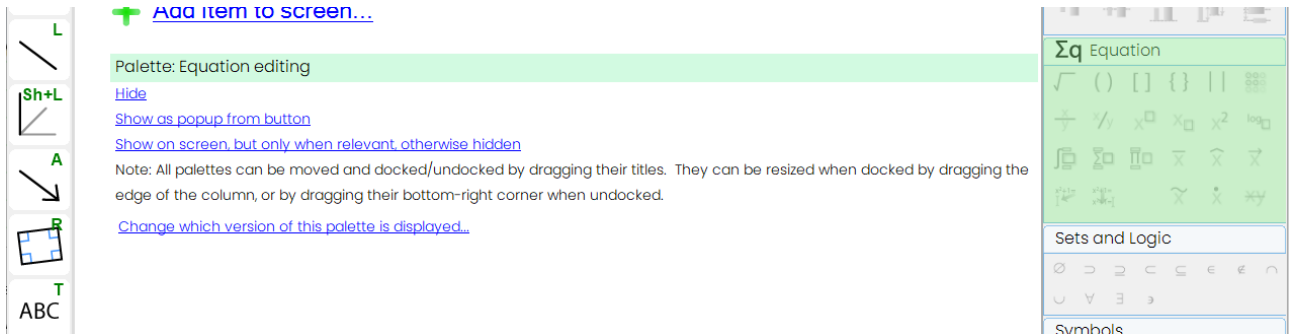
There are some such as with the upper-case greek characters which are not displayed by default, but could be added. There are also alternate versions of some of them.

To make any changes the easiest way in the current version of Splash is to press F10 to open the content editing screen:



To add a palette, select the "Add item to screen..." link and then choose it from the Palettes sub-menu. The equations ones are grouped together into a sub-menu of this.

To remove or modify an existing palette, click on it to select it first, and the options for it will be displayed:



Once selected there will be a "Hide" link which does just that. If there are alternatives available, the last option will be "Change which version of this palette is displayed".

## Adding content - keyboard style

*Note: this method may also be useful for students with only pointer control using an on-screen keyboard.*

To enter mathematical symbols from the keyboard first press the "#" key. Each symbol has a code and a description. You can enter either of these after the "#" key. At first the codes won't be known, so type part of the description to search:

x+ #arrow

adn	Arrow down
alt	Arrow left
art	Arrow right
aup	Arrow up
reeq	Reaction equilibrium arrow
rele	Reaction left arrow
veri	Reaction right arrow
vec	Vector arrow above

x #less

lt	Less than
ltae	Less than or approx equal
lte	Less than or equal
mlt	Much less than
nlt	Not less than
nltae	Not less than or approx equal
nlte	Not less than or equal

or

Use the up and down arrows to move through the list, and Enter to select the symbol and insert it into the equation. The blue menu then disappears.

If there are more than 8 results the list will scroll:

x #equal

app	Approx equals
gtae	Greater than or approx equal
gte	Greater than or equal
ide	Identically equal
ltae	Less than or approx equal
lte	Less than or equal
napp	Not approx equal
neq	Not equal
ngtae	Not greater than or approx equal

indicated by the arrow at the bottom (and top once scrolled).

When searching by description you don't need to enter the beginning of the description – it will return symbols whose description contains the text anywhere within it.

## Short codes

This menu shows both the code (on the left) and the description for each symbol (on the right). For symbols that are frequently used it is faster to use the code. If you type "#" and the code and press Enter the symbol is inserted without needing to scroll:

x+ #sqr

sqr	Square root
-----	-------------

When you first start typing after the "#" the search actually starts searching on the codes rather than the descriptions:

x+ #s

setcom	Set of complex numbers
setcon	Set contains
setint	Set of integers
setncon	Set does not contain
setrat	Set of rational numbers
setreal	Set of real numbers
si	Lower case Greek sigma
sim	Similar to
sqd	Squared

and then searches descriptions once enough text has been entered that it doesn't match the beginning of any codes.

## Other basic functions

**Cancelling:** if you want to cancel the search for a symbol, you can either press backspace enough times to erase the search and the initial "#" symbol. Backspace works as normal during the search. Alternatively pressing escape will cancel the symbol insert, removing the menu and the "#" which triggered it.

**Typing "#":** if you want to insert the "#" symbol itself in the equation, press the "#" twice. This immediately inserts the symbol; you don't need to use Enter to select it from the pop-up blue menu.

**Browse all:** if you want to see the entire list of symbols which can be inserted this way, type "\*" after the initial "#" and it will display the entire (long!) list, which you can scroll through.

## Special keys

There are some key combinations that can be used to type common symbols:

- Alt + P =  $\pi$  (lower case pi)
- Alt + / =  $\div$  (division symbol)
- Alt + 0 =  $^{\circ}$  (degree symbol)
- Alt + 8 =  $\cdot$  (multiplication dot)
- Alt + X = Curly x
- Alt + Y = Curly y

The key combination for the degree symbol can be used throughout Splash! The other keys only apply within the equation editor.

## Particular content types

### Fractions

We have already used examples of the normal divisor used in equations.

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

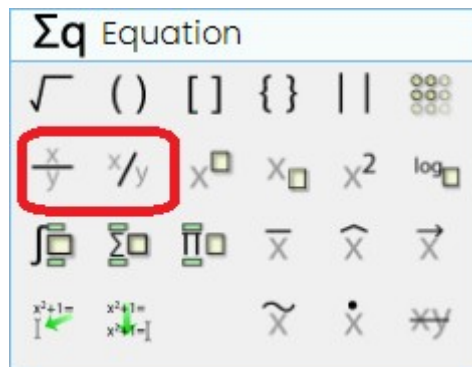
When writing out purely numeric fractions this presentation isn't always ideal, so there is an alternate version which can also be used:

$$56\frac{2}{3} \quad 56^{2/3}$$

The left version is the normal divisor (#div). On the right is the horizontal version (#divh). As usual as you can enter as much as you like on the top and bottom of this version:

$$56^{889/1000}$$

If using pointer-based input these are both on the main equations palette:



### Brackets

There were examples on p7 of how brackets in Splash will automatically expand based on their content. In order for this to work they are always entered as a pair. This likely seems natural for pointer-based input.

If using a keyboard the student should be aware that they only need to type the left one: ( [ or { and Splash will automatically insert the pair: ) ] or { } with the typing point inside the bracket. At the right-hand end, if is preferable to use the right-arrow key to step outside the bracket. Typing the right hand bracket *will* move the cursor out of the bracket – so if you type something like "(", "x", "+", "1, ")" it will work normally to produce "(x+1)". However this is only so if the cursor is just inside the right-hand bracket. If working with complex equations where the bracket may contain divisors, roots, integrals etc, using the arrow to navigate is recommended as it's easier to work through all the steps of the structure.

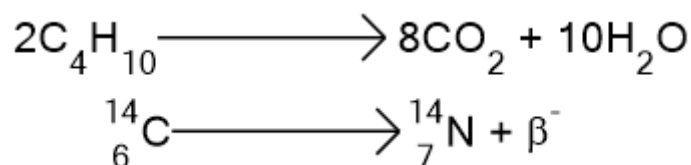
To remove any bracket use backspace to delete *either* half and both will be removed.

## Superscript and subscripts

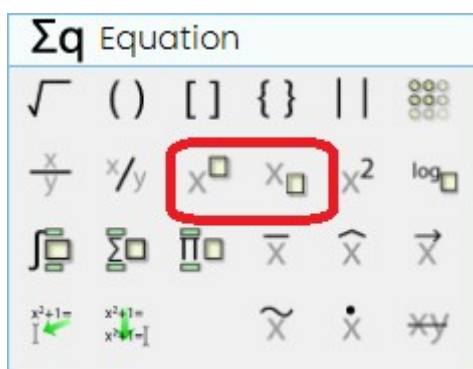
These are used extensively in Maths, especially for powers and logs:

$$x^2 + y^2 = 1 \quad \log_{10} \pi$$

Likewise in chemical equations and even more so in equations for nuclear isotopes:



These can be inserted as symbols, using #sup and #sub from the keyboard, or the buttons on the main Equation palette using a pointer:



Once they have been created, the up and down arrows should be used to navigate into them – scrolling along the equation horizontally will usually skip over them. You can navigate back out of the super/subscript either with the appropriate down/up arrow key, or moving horizontally out of the end will return to the main equation line.

If the equation is very complex with nested elements and the up and down arrows do not navigate in when expected, try from the left side of the super/subscript. This will prioritise the super/subscript. If the typing cursor is on the main line just to the right of the super/subscript Splash will usually prioritise larger movements – such as going to the other half of a divisor.

### Quick creation

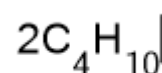
As a shortcut you can also usually create superscript or subscripts by pressing the up or down arrows when the typing point is at a normal position in the equation. This will move the cursor to the super/subscript position even if there was nothing there previously.

So, for example "x" "up arrow", "2", "down arrow" would type:

$$x^2$$

(although there is also an option to insert a 'squared' item)

This can be particularly useful in situation that use a lot of super/subscripts, such as chemistry. So this can be typed as "2" "C" "down" "4" "up" "H" "10"

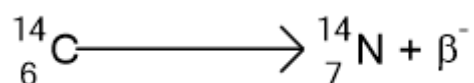


However – this might not function if the up or down arrow has another natural use. For example if you are on the bottom of a divisor, then "up" will move the

typing above the line. In this case you would need to use the #sup / #sub symbol options as described above.

## At the start of the equation

In the rare case that you want a super/subscript right at the start of the line, such as in:



you should note that Splash won't actually insert a super/subscript until there is something on the main line to attach them to. So to type the above you need to first type the "C", move the cursor left one, and then use the down or up arrows to navigate to the positions above and below.

If you press the up and down arrows, or use the #sup and #sub codes in a blank line (or within an empty bracket, for example) nothing will happen.

## Matrices

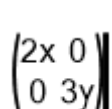
Splash supports matrices and vectors:


$$\begin{pmatrix} 2x & 0 \\ 0 & 3y \end{pmatrix}$$

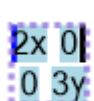
There is a matrices palette which will insert various sizes of matrix/vector. However you can also add/remove rows and columns once one has initially been added to get any size. New rows/columns are always added to the end. When deleting the row/column containing the typing cursor is removed.

You navigate around the cells using the 4 arrows keys much as you would expect. Left/right will move through the text in one position, moving to the adjacent position once off the end. Keep navigating left or right off the end of one of the edge cells to step entirely outside the matrix.

These options usually insert a matrix using parentheses - ( ) to surround it. However the ( ) are actually independent and can be removed or changed without affecting the matrix cells. For example to change the above example to be within [ ] instead, the steps are:

 Start with the typing point just outside the right-hand parenthesis.

 Pressing backspace will remove the ( ) as normal, leaving the typing point within one of the cells.

 Then shift + left arrow is used until the entire matrix shows as selected.

 Finally pressing the "[" key or selecting the "[ ]" button on the Equation palette will wrap the selection in [ ]