Getting nice equations in the text

Ignas Anikevicius

July 26, 2011

In this short tutorial I will explain how to make simple equations. This will include chemical equations as well. In order to get the required packages in order to do these things, please look in to the source (.tex) file of this document. If you feel, that you need more information on typesetting various mathematical formulas, please refer to this online book.

1 Single-line mathematical equations

Many might want to have numbered equations in the text. For example you are writing a lot of text and then you want to make **one** numbered equation, which would start at a new line. As follows:

$$\mathrm{d}f = \frac{\partial f}{\partial x}\mathrm{d}x + \frac{\partial f}{\partial y}\mathrm{d}y \tag{1}$$

Then you can refer to the equation 1 by using a simple `\ref{eq:differential}` command.

The code required to get equation 1 is as follows (NB I used custom commands to simplify the code. On making such commands, please read another document):

```
\begin{equation}
    \dd f = \DP f x \dd x + \DP f y \dd y
    \label{eq:differential}
\end{equation}
```

Just for completeness, this code would need to be written down without my simple custom additions:

```
\begin{equation}
    \mathrm{d}f = \cfrac{\partial f}{\partial x}\mathrm{d}x
                + \cfrac{\partial f}{\partial y}\mathrm{d}y
    \label{eq:differential}
\end{equation}
```

No we now how to produce a numbered equation. What about unnumbered? It is very easy, we can just $*$ symbols as follows:

```
\begin{equation*}
    \dd f = \DP f x \dd x + \DP f y \dd y
\end{equation*}
```

And the result is (NB we do not need label any more, since this is an unnumbered equations and we **do not** intend to refer it later on in the text):

$$\mathrm{d}f = \frac{\partial f}{\partial x}\mathrm{d}x + \frac{\partial f}{\partial y}\mathrm{d}y$$

There is another way to get this effect by using the following code (`\[` and `\]` can be replaced with `$$`, however the first variant shows more clarity as to where the environment starts and finishes):

```
\[
    \dd f = \DP f x \dd x + \DP f y \dd y
\]
```

And the result is as follows:

$$\mathrm{d}f = \frac{\partial f}{\partial x}\mathrm{d}x + \frac{\partial f}{\partial y}\mathrm{d}y$$

2 Multiple-line mathematical equations

Many line equations are slightly different to produce. Many probably know the environments called `eqnarray` and `eqnarray*`, which can be used to produce the following set of equations (the starred version will produce unnumbered version as before):

$$\begin{aligned} \mathrm{d}f &= \frac{\partial f}{\partial x}\mathrm{d}x + \frac{\partial f}{\partial y}\mathrm{d}y && (2)\\ \mathrm{d}g &= \frac{\partial g}{\partial x}\mathrm{d}x + \frac{\partial g}{\partial y}\mathrm{d}y + \frac{\partial g}{\partial z}\mathrm{d}z && (3)\\ \mathrm{d}h = \frac{\partial h}{\partial x}\mathrm{d}x &+ \frac{\partial h}{\partial y}\mathrm{d}y && (4) \end{aligned}$$

with code:

```
\begin{eqnarray}
    \dd f &=& \DP f x \dd x + \DP f y \dd y
    \label{eq:exact_multi1}
    \\
    \dd g &=& \DP g x \dd x + \DP g y \dd y + \DP g z \dd z
    \label{eq:exact_multi2}
    \\
    \dd h = \DP h x \dd x &+& \DP h y \dd y
    \label{eq:exact_multi3}
\end{eqnarray}
```

However, one can notice, that the spacing around = sign is not perfect (although some might like it). A much better approach is to use `align` environment, which has even more

capabilities.

$$\begin{aligned} \mathrm{d}f &= \frac{\partial f}{\partial x}\mathrm{d}x + \frac{\partial f}{\partial y}\mathrm{d}y \\ \mathrm{d}g &= \frac{\partial g}{\partial x}\mathrm{d}x + \frac{\partial g}{\partial y}\mathrm{d}y + \frac{\partial g}{\partial z}\mathrm{d}z \\ \mathrm{d}h &= \frac{\partial h}{\partial x}\mathrm{d}x + \frac{\partial h}{\partial y}\mathrm{d}y \end{aligned} \tag{5}$$

The code to generate the equations above is (NB different syntax!)

```
\begin{align}
    \dd f &= \DP f x \dd x + \DP f y \dd y
    \nonumber
    \\
    \dd g &= \DP g x \dd x + \DP g y \dd y + \DP g z \dd z
    \label{eq:exact_align}
    \\
    \dd h = \DP h x \dd x &+ \DP h y \dd y
    \nonumber
\end{align}
```

3 Chemical equations

Now we come to a more interesting topic. How to typeset chemical equations quickly? Suppose we have an equation as follows:

$$6\mathrm{KSCN} + \mathrm{FeCl_3} \rightarrow \mathrm{K_3[Fe(SCN)_6]} + 3\mathrm{KCl}$$

One way to typeset it would be to use existing commands and the code required would be as follows:

```
\[
\mathrm{6 KSCN + FeCl_3 \rightarrow K_3[Fe(SCN)_6] + 3 KCl}
\]
```

It is not bad, but if we have a following equation:

$$\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4\downarrow}$$

would require you to type the following:

```
\[
\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4\downarrow}
\]
```

And this might complicate the things even more:

$$\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq) \xrightarrow[\text{bellow}]{\text{above}} BaSO_4\downarrow}$$

```
\[
\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq)
\underset{bellow}{\overset{above}{\longrightarrow}} BaSO_4\downarrow
    }
\]
```

As you see, the more complicated the equation gets, the harder it is to fulfil all the requirements. For example you can see, that the last equation does not have a properly spaced arrow, which would be very nice to have.

However, it is very nice, that LaTeX is very extensible and open source and a lot of people have contributed their time and knowledge to get it work as **we** want and need. For chemical reactions and other symbols typesetting I suggest you using the `mhchem` package which should already be bundled with your TeX distribution. To start using it just include `\usepackage[version=3]{mhchem}` into your preamble.

The following code using this package produce better formatted equations.

```
\begin{align}
    \ce{6KSCN + FeCl3 -> K3[Fe(SCN)6] + 3KCl}
    \nonumber
    \\
    \ce{Ag+(aq) + Cl-(aq) -> AgCl v}
    \nonumber
    \\
    \ce{Ba^{2+}(aq) + SO4^{2-}(aq) -> BaSO4 v}
    \\
    \ce{Ba^{2+}(aq) + SO4^{2-}(aq) ->[\mathrm{above}][\mathrm{bellow}] BaSO4 v}
    \nonumber
\end{align}
```

and we get:

$$\begin{aligned}
6\,\mathrm{KSCN} + \mathrm{FeCl_3} &\longrightarrow \mathrm{K_3[Fe(SCN)_6]} + 3\,\mathrm{KCl} \\
\mathrm{Ag^+(aq) + Cl-(aq)} &\longrightarrow \mathrm{AgCl}\downarrow \\
\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq)} &\longrightarrow \mathrm{BaSO_4}\downarrow \\
\mathrm{Ba^{2+}(aq) + SO_4^{2-}(aq)} &\xrightarrow[\text{bellow}]{\text{above}} \mathrm{BaSO_4}\downarrow
\end{aligned} \tag{6}$$

For more capabilities of the package it would be possibly best to flick through through the documentation of the package which can be found following this link.