

# 1 Getting started with L<sup>A</sup>T<sub>E</sub>X

## 1.1 Overleaf

Create an account at [Overleaf](#). Then ‘Create First Project’ → Blank Project. Let the name of your project be ‘LaTeX Workshop Aardwetenschappen’. Delete all the code in the Source tab.

## 1.2 A simple document

Create a document that uses `\documentclass{article}`. Use a4-paper. Create some sections using the commands `\section`, `\subsection` and `\paragraph`. Regularly *Recompile* to see what your document looks like.

By now your source code should look like this:

```
\documentclass[a4paper]{article}

\begin{document}

\section{the first section}
some text in the first section

\section{the second section}
some text in the second section

\subsection{a subsection}
some text in the first subsection

\subsection{another}
some text in the second subsection

\paragraph{a paragraph header}
some text in a paragraph

\end{document}
```

## 1.3 Title, date and author

Give the document a title using the `\title{document title}` command and an author using the `\author{the author's name}` command. Include a date with the `\date` command. Do not forget to add `\maketitle` directly after `\begin{document}`. By now the document should look like this:

```
\documentclass[a4paper]{article}

\title{my article}
\author{the author}
\date{4 March 2022}

\begin{document}

\maketitle

:
:

\end{document}
```

## 1.4 Formatting text

Recreate the text in the box, using the following commands.

- `\textbf` **bold**
- `\textit` *italic*
- `\underline` underline
- `\sout` ~~strikethrough~~      add to preamble: `\usepackage[normalem]{ulem}`
- `\textsc` SMALL CAPS

We consider a ~~horizontal~~ vertical cross section of an INFINITELY LONG POLDER. The polder consists of a **confined** *aquifer*.

## 1.5 Color

To use color add the following code to your preamble: `\usepackage{xcolor}`. Now you can use `\textcolor{red}{red text here}` to make the rainbow below.

The colors used are 'red', 'orange', 'yellow', 'green', 'blue', 'indigo' and 'violet'. But 'indigo' is not one of the defined colors in LaTeX. The easiest way to use this color is to find the RGB values for indigo(dye) at [latexcolor.com](http://latexcolor.com). Put `\definecolor{indigo}{rgb}{0.0, 0.25, 0.42}` in your preamble to use this new color.

Rainbow

## 1.6 Text size

Use `{\Large Text}` for larger text. Other options are:

|                            |              |
|----------------------------|--------------|
| <code>\tiny</code>         | tiny         |
| <code>\scriptsize</code>   | scriptsize   |
| <code>\footnotesize</code> | footnotesize |
| <code>\small</code>        | small        |
| <code>\normalsize</code>   | normalsize   |
| <code>\large</code>        | large        |
| <code>\Large</code>        | Large        |
| <code>\LARGE</code>        | LARGE        |
| <code>\huge</code>         | huge         |
| <code>\Huge</code>         | Huge         |

Now recreate the following text:

We consider a **Large** vertical cross section of an infinitely tiny polder. The polder consists of a **Huge** confined aquifer.

## 1.7 Curly braces

Try the following commands with and without curly braces: `\underline Test` vs `\underline{Test}` en `\section Titel` vs `\section{Titel}`. What is the purpose of curly braces in L<sup>A</sup>T<sub>E</sub>X?

## 2 Math

Recreate the following math content:

I can write inline math such as  $a^2 + b^2 = c^2$ . I can also give equations their own space:

$$\|\vec{x} + \vec{y}\| \leq \|\vec{x}\| + \|\vec{y}\| \quad (1)$$

$$\int_a^b x^2 dx = \frac{1}{3}(a^3 - b^3) \quad (2)$$

|                                                                                               |                        |
|-----------------------------------------------------------------------------------------------|------------------------|
| $q = -\frac{k}{\mu L} \Delta p$                                                               | Darcy's Law            |
| $\frac{\Delta p}{L} = -\frac{150\mu}{\Phi_s^2 D_p^2} \frac{(1 - \epsilon)^2}{\epsilon^3} u_s$ | Kozeny–Carman equation |

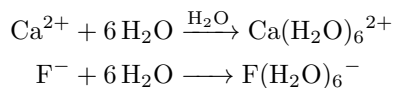
## 3 Chemistry

Use `\usepackage[version=4]{mhchem}` for chemical formulas. Consult the documentation at [ctan.org/pkg/mhchem](http://ctan.org/pkg/mhchem) (Package documentation PDF).

Now recreate the following excerpt from a geochemistry book:

The most fundamental of all aqueous geochemical reactions is the dissociation of water:  $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$ . The pH scale for water changes with temperature. At  $0^\circ\text{C}$   $K_{\text{H}_2\text{O}} = 10 - 14.9$  and the pH is 7.45.

In the dissolution of fluorite the hydration role played by water is not explicitly written, but the hydration reactions and their aqueous complex can be approximated by:



## 4 Tables

Recreate the following tables using the `\tabular` command. There exist many packages for creating tables, some of them are listed [here on stackexchange](#).

|       |       |
|-------|-------|
| cell1 | cell2 |
| cell3 | cell4 |

|         |    |   |    |
|---------|----|---|----|
| $x$     | -2 | 0 | 2  |
| $f(x)$  | -8 | 0 | 8  |
| $f'(x)$ | 12 | 0 | 12 |

| Mineral           | Albite | Anorthite |
|-------------------|--------|-----------|
| SiO <sub>2</sub>  | 68.74  | 43.19     |
| Na <sub>2</sub> O | 11.82  | 0.0       |

Table 1: Mineral compositions in oxide wt. %

## 5 Figures

Recreate [Figure 1](#). Use `\caption` and `width=0.5\textwidth`. The position of the figure should be at the bottom of the page if possible, otherwise approximately *here* in the text or on a special page for floats.

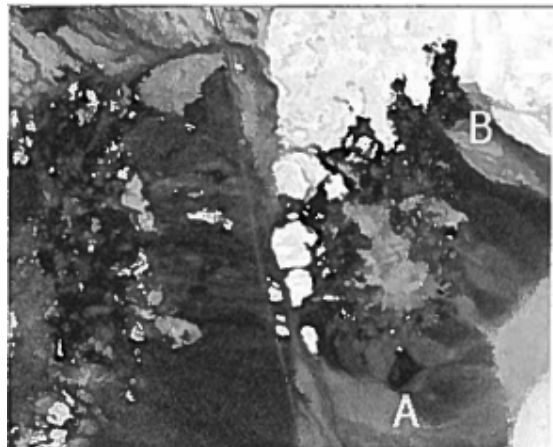


Figure 1: SAM result for Kaolinite in Cuprite, Nevada desert in the USA deribed on an AVIRIS image.

## 6 Labels and cross-referencing

Add labels to *the triangle inequality*, *the table of mineral compositions* and *the picture of kaolinite*. Create a list with a reference to each. *hint*: use `\usepackage[bookmarksnumbered]{hyperref}` en the command `\autoref`.

- The triangle inequality: [Equation 1](#)

- Mineral compositions: [Table 1](#)
- Kaolinite: [Figure 1](#)

## 7 The bibliography

We will now create a bibliography with a single article.

Find the article by “*Optimization of water level monitoring network in polder systems using information theory*” on [scholar.google.com](https://scholar.google.com), press ” Cite and then BibTeX. Copy this text.

Create a new file on Overleaf called `mybibliography.bib`. Paste the text from Google Scholar into this new file.

Now cite the article somewhere in your document, using `\cite` and add a bibliography at the end of your document, just before `\end{document}` *hint*:

```

:
... the general solution of the well-known \emph{Polder Problem}\cite{alfonso2010}
:
\bibliographystyle{plain}
\bibliography{literatuur.bib}
\end{document}

```

The hydraulic head distribution in the Polder satisfies the general solution of the well-known *Polder Problem*[?].

## 8 Final assignment

Use what you have learned to recreate the following (fictional) scientific article. The solution will be made available at [vkuhlmann.com/latex](https://vkuhlmann.com/latex)

Hints:

1. The margins are 2.54cm and the document uses A4 paper.
2. Create a `\newcommand` for [m/s] and [m].
3. Use `\usepackage[version=4]{mhchem}` for chemical formulae. You can find the documentation at [ctan.org/pkg/mhchem](https://ctan.org/pkg/mhchem)
4. Use the package `parskip` `parskip`.
5. Use `newpage` directly after `tableofcontents`

# Principles of Groundwater Flow

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September 26, 2022

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# 1 The polder problem

1. We consider a vertical cross section of an INFINITELY LONG POLDER. The polder consists of a confined aquifer with hydraulic conductivity  $k_1$  [m/s] and thickness  $D$  [m]. The **top** layer has thickness  $b$  [m] and hydraulic conductivity  $k_2$  [m/s]. We refer to  $h_p$  [m] as ‘Polder level’. Note that  $h(+\infty) = h_p$ . The ambient air temperature is  $23^\circ\text{C}$ .

The hydraulic head distribution in the Polder satisfies the general solution of the well-known *Polder Problem*[?]:

$$h(x) = C_1 e^{+\frac{x}{\lambda}} + C_2 e^{-\frac{x}{\lambda}} + h_p \quad (1)$$

Where  $\lambda$  is the seepage factor

$$\lambda = \sqrt{\frac{k_1}{k_2} b D} \quad (2)$$

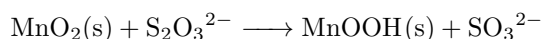
and  $C_1$  and  $C_2$  are yet unknown constants.

- (a) Determine the constants  $C_1$  and  $C_2$
- (b) Explain in words why it follows from [Equation 1](#), that the following equalities must both hold:

$$Q'(0) = \frac{k_1 D}{\lambda} (h_0 - h_p)$$

$$Q'(0) = \int_0^{+\infty} q_z(s) ds$$

2. Balance the following redox equation (using  $\text{H}^+$  and  $\text{H}_3\text{O}^+$ )



# 2 Mineral compositions

[Table 1](#) contains information about the composition of certain minerals.

| Mineral               | Albite | Anorthite |
|-----------------------|--------|-----------|
| $\text{SiO}_2$        | 68.74  | 43.19     |
| $\text{Na}_2\text{O}$ | 11.82  | 0.0       |

Table 1: Mineral compositions in oxide wt. %

# 3 Kaolinite in cuprite

## 3.1 Chemical composition

Kaolinite is a **clay mineral**, with the chemical composition  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ . Cuprite is a **brownish-red** mineral. The average kaolin price is estimated to reach ~~\$160~~ \$180 per ton by 2025.

## 3.2 Deposits in Nevada

Recent measurements show deposits of the mineral kaolinite in cuprite in the Nevada desert, as seen in [Figure 1](#).

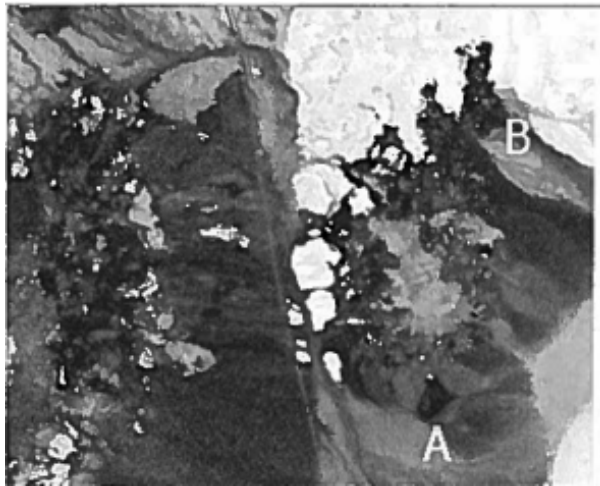


Figure 1: SAM result for Kaolinite in Cuprite, Nevada desert in the USA derived on an AVIRIS image.