# calc_decimal_example

## Student Group

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## Table of Contents

$I.\quad$ Calculation example for decimal value

Idea: The number $2658.47$ is only the representation with the numerals $[0..9]$, but what is the value behind it?

\begin{align*} \begin{smallmatrix} \color{black}{\text{number}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{white}{\text{index}:} & \color{white}{i} & \color{white}{3} & \color{white}{2} & \color{white}{1} & \color{white}{0 } & \color{white}{-1} & \color{white}{-2} \\ \color{white}{\text{place value}:} & \color{white}{B^i} & \color{white}{10^3} & \color{white}{10^2} & \color{white}{10^1} & \color{white}{10^0} & \color{white}{10^{-1}} & \color{white}{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{numerals}:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{calc.}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*} First: But space between the numerals to see the thousands, hundreds, tens, ones, tenths, hundredths

\begin{align*} \begin{smallmatrix} \color{black}{\text{number}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{blue }{\text{index}:} & \color{blue }{i} & \color{blue }{3} & \color{blue }{2} & \color{blue }{1} & \color{blue }{0 } & \color{blue }{-1} & \color{blue }{-2} \\ \color{white}{\text{place value}:} & \color{white}{B^i} & \color{white}{10^3} & \color{white}{10^2} & \color{white}{10^1} & \color{white}{10^0} & \color{white}{10^{-1}} & \color{white}{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{numerals}:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{calc.}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}

\begin{align*} \begin{smallmatrix} \color{black}{\text{number}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{blue }{\text{place value}:} & \color{blue }{B^i} & \color{blue }{10^3} & \color{blue }{10^2} & \color{blue }{10^1} & \color{blue }{10^0} & \color{blue }{10^{-1}} & \color{blue }{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{numerals}:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{calc.}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} &

$$\color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

$$\begin{align*} \begin{smallmatrix} \color{white}{\text{number}:} & \color{white}{} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8.} & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{index}:} & \color{white}{i} & \color{white}{3} & \color{white}{2} & \color{white}{1} & \color{white}{0 } & \color{white}{-1} & \color{white}{-2} \\ \color{white}{\text{place value}:} & \color{white}{B^i} & \color{white}{10^3} & \color{white}{10^2} & \color{white}{10^1} & \color{white}{10^0} & \color{white}{10^{-1}} & \color{white}{10^{-2}} \\ \color{white}{} & \color{white}{} & \color{white}{1000} & \color{white}{100 } & \color{white}{10 } & \color{white}{1 } & \color{white}{0.1 } & \color{white}{0.01 } \\ \color{white}{\text{numerals}:} & \color{white}{z_i} & \color{white}{2} & \color{white}{6} & \color{white}{5} & \color{white}{8 } & \color{white}{4} & \color{white}{7} \\ \color{white}{\text{calc.}:} & \color{white}{z_i \cdot B^i} & \color{white}{2000} & \color{white}{600} & \color{white}{50} & \color{white}{8 } & \color{white}{0.4} & \color{white}{0.07} \\ \color{white}{\text{result}:} & \color{white}{\sum_i{ z_i \cdot B^i }} & & & \color{white}{2658.47} \\ \end{smallmatrix} \end{align*}$$

$$\begin{align*} \begin{smallmatrix} \color{blue }{\text{number}:} & \color{blue }{} & \color{blue }{2} & \color{blue }{6} & \color{blue }{5} & \color{blue }{8.} & \color{blue }{4} & \color{blue }{7} \\ \color{blue }{\text{index}:} & \color{blue }{i} & \color{blue }{3} & \color{blue }{2} & \color{blue }{1} & \color{blue }{0 } & \color{blue }{-1} & \color{blue }{-2} \\ \color{blue }{\text{place value}:} & \color{blue }{B^i} & \color{blue }{10^3} & \color{blue }{10^2} & \color{blue }{10^1} & \color{blue }{10^0} & \color{blue }{10^{-1}} & \color{blue }{10^{-2}} \\ \color{blue }{} & \color{blue }{} & \color{blue }{1000} & \color{blue }{100 } & \color{blue }{10 } & \color{blue }{1 } & \color{blue }{0.1 } & \color{blue }{0.01 } \\ \color{blue }{\text{numerals}:} & \color{blue }{z_i} & \color{blue }{2} & \color{blue }{6} & \color{blue }{5} & \color{blue }{8 } & \color{blue }{4} & \color{blue }{7} \\ \color{blue }{\text{calc.}:} & \color{blue }{z_i \cdot B^i} & \color{blue }{2000} & \color{blue }{600} & \color{blue }{50} & \color{blue }{8 } & \color{blue }{0.4} & \color{blue }{0.07} \\ \color{blue }{\text{result}:} & \color{blue }{\sum_i{ z_i \cdot B^i }} & & & \color{blue }{2658.47} \\ \end{smallmatrix} \end{align*}$$

$$\begin{align*} \begin{smallmatrix} \color{black}{\text{number}:} & \color{black}{} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8.} & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{index}:} & \color{black}{i} & \color{black}{3} & \color{black}{2} & \color{black}{1} & \color{black}{0 } & \color{black}{-1} & \color{black}{-2} \\ \color{black}{\text{place value}:} & \color{black}{B^i} & \color{black}{10^3} & \color{black}{10^2} & \color{black}{10^1} & \color{black}{10^0} & \color{black}{10^{-1}} & \color{black}{10^{-2}} \\ \color{black}{} & \color{black}{} & \color{black}{1000} & \color{black}{100 } & \color{black}{10 } & \color{black}{1 } & \color{black}{0.1 } & \color{black}{0.01 } \\ \color{black}{\text{numerals}:} & \color{black}{z_i} & \color{black}{2} & \color{black}{6} & \color{black}{5} & \color{black}{8 } & \color{black}{4} & \color{black}{7} \\ \color{black}{\text{calc.}:} & \color{black}{z_i \cdot B^i} & \color{black}{2000} & \color{black}{600} & \color{black}{50} & \color{black}{8 } & \color{black}{0.4} & \color{black}{0.07} \\ \color{black}{\text{result}:} & \color{black}{\sum_i{ z_i \cdot B^i }} & & & \color{black}{2658.47} \\ \end{smallmatrix} \end{align*}$$

| value | | 2 | 6 | 5 | 8 , | 4 | 7 | |
|---|---|---|---|---|---|---|---|---|
| index | $i$ | 3 | 2 | 1 | 0 | -1 | -2 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\quad\quad$ $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ |
| $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | |
| $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | |
| $\quad\quad$ $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | $\quad\quad$ | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| value | | 2 | 6 | 5 | 8 , | 4 | 7 |
| index | $i$ | 3 | 2 | 1 | 0 | -1 | -2 |
| place value | $B^i$ | $\small{10^3}$ $\small{1000}$ | $\small{10^2}$ $\small{100}$ | $\small{10^1}$ $\small{10}$ | $\small{10^0}$ $\small{1}$ | $\small{10^-1}$ $\small{0.10}$ | $\small{10^-2}$ $\small{0.01}$ |
| digit | $z_i$ | 2 | 6 | 5 | 8 | 4 | 7 |
| calc. | $z_i \cdot B^i$ | 2000 | 600 | 50 | 8 | 0.4 | 0.07 |
| Result $\sum_i{ z_i \cdot B^i }$ | | 2658,47 | | | | | |

| | | |
|---|---|---|
| aus (2+3) | $\color{blue}{I_p} = \color{blue}{I_m} = 0$ | $I_p$ und $I_m$ sind damit definiert |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| aus (6) | $\color{blue}{I_o} = I_1 $ | $I_o$ ist damit bekannt, wenn $I_1$ bekannt ist |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| aus (7) und (3) | $I_1 - I_2 -\color{blue}{0} = 0 $ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $I_1 = I_2 = I_o$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $\color{blue}{I_1} = \color{blue}{I_2} = \color{blue}{I_o} $ | mit (8) und (9): $I_\boxed{}=\frac{U_\boxed{}}{R_\boxed{}}$ und (5) |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $\frac{U_1}{R_1}= \frac{U_2}{R_2} = \frac{U_A}{R_1 + R_2}$ | Spannungsteilerformel, $I=const.$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| (10) | $U_2= U_A\cdot\frac{R_2}{R_1+R_2}$ | Spannungsteilerformel |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |

## $II.\quad$ Betrachtung der Spannungsverstärkung

| | | |
|---|---|---|
| aus (0) | $\color{blue}{A_V}=\frac{U_A}{U_E}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{\color{blue}{U_E}}$ | mit (4): $U_E=U_2+U_D$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{\color{blue}{U_2+U_D}}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{\color{blue}{U_2}+U_D}$ | mit (10): $U_2= U_A\cdot\frac{R_2}{R_1+R_2}$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{\color{blue}{U_A\cdot\frac{R_2}{R_1+R_2}}+U_D}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{U_A\cdot\frac{R_2}{R_1+R_2}+U_D}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{U_A\cdot\frac{R_2}{R_1+R_2}+\color{blue}{U_D}}$ | mit (1) |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{U_A\cdot\frac{R_2}{R_1+R_2}+\color{blue}{\frac{U_A}{A_D}}}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{U_A\cdot\frac{R_2}{R_1+R_2}+\frac{U_A}{A_D}}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{U_A}{U_A\cdot\frac{R_2}{R_1+R_2}+\frac{\color{blue}{U_A}}{A_D}}$ | Erweitern mit $\frac{1}{U_A}$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{1}{\frac{R_2}{R_1+R_2}+\frac{1}{A_D}}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{1}{\frac{R_2}{R_1+R_2}+\color{blue}{\frac{1}{A_D}}}$ | mit $\frac{1}{A_D} \xrightarrow{A_D \rightarrow \infty} 0$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{1}{\frac{R_2}{R_1+R_2}}$ | Bruch umformen |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |
| $\quad$ | $A_V=\frac{R_1+R_2}{R_2}$ | $\quad$ |
| $\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ | $\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ |

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