

# Basic mathematical symbols and structures

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# 1 Standard mathematical symbols

We will use the robust single dollar environment for these

Math versions of text symbols:  $\$ \ddagger \{ \P \dots \} \S \dagger \mathcal{L}$

Keyboard symbols:  $+ - = < > / : ! | [ ] ( )$

But for longer tests we will use the equation environment so that we don't overrun the line if we increase the font size.

Greek:

$$\alpha\beta\gamma\delta\epsilon\zeta\eta\theta\iota\kappa\lambda\mu\nu\xi\omicron\pi\rho\sigma\tau\upsilon\phi\chi\psi\omega \quad (1)$$

Upper case Greek:

$$\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega \quad (2)$$

Normal, lower case:

$$a b c d e f g h i j k l m n o p q r s t u v w x y z \quad (3)$$

Normal, upper case:

$$A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \quad (4)$$

Bold using boldmath, lower case:

$$\boldsymbol{a b c d e f g h i j k l m n o p q r s t u v w x y z} \quad (5)$$

Bold using boldmath, upper case:

$$\boldsymbol{A B C D E F G H I J K L M N O P Q R S T U V W X Y Z} \quad (6)$$

Italic, lower case:

$$\textit{a b c d e f g h i j k l m n o p q r s t u v w x y z} \quad (7)$$

Italic, upper case:

$$\textit{A B C D E F G H I J K L M N O P Q R S T U V W X Y Z} \quad (8)$$

Roman, lower case:

$$\text{abcdefghijklmnopqrstuvwxyz} \quad (9)$$

Roman, upper case:

$$A B C D E F G H I J K L M N O P Q R S T U V W X Y Z \quad (10)$$

Bold using bf, lower case:

$$\text{abcdefghijklmnopqrstuvwxyz} \quad (11)$$

Bold using bf, upper case:

$$\text{ABCDEFGHIJKLMNOPQRSTUVWXYZ} \quad (12)$$

Calligraphic (upper case only):

$$ABCDEFGHIJKLMNOPQRSTUVWXYZ \quad (13)$$

Binary operators:

$$\pm \mp \times \div \cdot * \star \dagger \ddagger \amalg \cap \cup \uplus \sqcap \sqcup \vee \wedge \oplus \ominus \otimes \circ \bullet \diamond \oslash \odot \bigcirc \triangle \nabla \ll \gg \setminus \quad (14)$$

Relations:

$$\leq \leq \ll \subset \subseteq \sqsubset \sqsupset \vdash \rhd \gg \ggg \supset \supseteq \ni \neq \dot{=} \approx \cong \propto \gamma \Upsilon || || \sim \simeq \times \smile \frown \bowtie \curlywedge \Upsilon | \quad (15)$$

Negated:

[illegible]

Arrows:

$$\leftarrow \dashrightarrow \rightrightarrows \rightarrow \Rightarrow \Leftrightarrow \Uparrow \Downarrow \curvearrowright \hookrightarrow \hookleftarrow \rightsquigarrow \longleftarrow \Longleftrightarrow \longrightarrow \Longrightarrow \quad (17)$$

$$\longleftrightarrow \rightleftharpoons \rightleftharpoons \vdash \rightarrow \hookrightarrow \rightarrow \uparrow \uparrow \downarrow \downarrow \uparrow \downarrow \nearrow \searrow \nwarrow \nearrow \quad (18)$$

Other:

$$\aleph \hbar \gamma \ell \wp \Re \mathcal{S} \mathcal{I} \mathcal{O} \nabla \sqrt{\partial} \top \perp \vdash \forall \exists \neq \mathfrak{q} \mathfrak{q} \parallel \parallel \backslash \gamma \Delta \clubsuit \diamondsuit \heartsuit \spadesuit \infty \quad (19)$$

Symbols with two sizes:

$$\frac{\Sigma \int \oint \Pi \amalg \cap \sqcup \vee \wedge \odot \otimes \oplus \uplus}{\Sigma \int \oint \Pi \amalg \cap \sqcup \vee \wedge \odot \otimes \oplus \uplus} \quad (20)$$

Function names:

$$\arccos \arcsin \arctan \arg \cos \cosh \cot \coth \csc \deg \det \quad (21)$$

$$\dim \exp \gcd \operatorname{hom} \inf \ker \lg \lim \liminf \limsup \ln \log \quad (22)$$

$$\max \min \Pr \sec \sin \sinh \sup \tan \tanh \quad (23)$$

Those with under-subscript available:

$$\det \gcd \inf \lim \lim \inf \lim \sup \max \min \Pr \sup \quad (24)$$

$$\text{Modulus:} \quad a \bmod b \quad a \pmod{b} \quad (25)$$
$$\hat{a}\check{a}\grave{a}\ddot{a}\dot{\bar{a}}\ddot{\bar{a}}\tilde{a}\acute{a}\vec{a}\widehat{a}\widetilde{a}\overline{a}aaa\underline{aaa}\overset{\frown}{aaa}aaa \quad (26)$$
$$\left(\frac{1}{2}\right) \left[\frac{1}{2}\right] \left\{\frac{1}{2}\right\} \left|\frac{1}{2}\right| / \frac{1}{2} \setminus \left[\frac{1}{2}\right] \left[\frac{1}{2}\right] \left\langle\frac{1}{2}\right\rangle \quad (27)$$
$$() \{\} \sqcup \sqcap \langle \rangle \wedge \parallel \uparrow \uparrow \downarrow \downarrow \updownarrow \updownarrow \quad (28)$$
$$(), \{\}, \llbracket \rrbracket, \langle \rangle, \wedge, \vee, \uparrow, \downarrow, \updownarrow \quad (29)$$
$$(\quad) \parallel \{\} \mid \square \diamond \triangle \parallel \uparrow \downarrow \updownarrow \quad (30)$$
$$\begin{pmatrix} \circ \\ \square \\ \{ \\ \sqcup \\ \sqcap \\ \diamond \\ \wedge \\ \parallel \\ \uparrow\uparrow \\ \downarrow\downarrow \\ \updownarrow\updownarrow \end{pmatrix} \quad (31)$$
$$a \dots a \quad a \dot{:} a \quad a \cdots a \quad a \dot{\cdot} \cdot a \quad (32)$$
$$\begin{array}{ccccccc} | & | & | & | & | & & | \end{array} \quad (33)$$

Three different ways to inline  $A_{i,j,k}^{2^n}$   $A_{i,j,k}^{2^n}$   $A_{i,j,k}^{2^n}$   
Four different ways to displaymath.

$$\sum_{i=1}^{15} x_i^2 = x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2 + x_{14}^2 + x_{15}^2 \quad (100)$$

$$x_1^2 = x_2^2 = x_3^2 = x_4^2 = x_5^2 = x_6^2 = x_7^2 = x_8^2 = x_9^2 = x_{10}^2 = x_{11}^2 = x_{12}^2 = x_{13}^2 = x_{14}^2 = x_{15}^2$$

$$\prod_{i=1}^{15} x_i^2 = x_1^2 \ x_2^2 \ x_3^2 \ x_4^2 \ x_5^2 \ x_6^2 \ x_7^2 \ x_8^2 \ x_9^2 \ x_{10}^2 \ x_{11}^2 \ x_{12}^2 \ x_{13}^2 \ x_{14}^2 \ x_{15}^2$$

$$\prod_{i=1}^{15} x_i^2 = x_1^2 \cdot x_2^2 \cdot x_3^2 \cdot x_4^2 \cdot x_5^2 \cdot x_6^2 \cdot x_7^2 \cdot x_8^2 \cdot x_9^2 \cdot x_{10}^2 \cdot x_{11}^2 \cdot x_{12}^2 \cdot x_{13}^2 \cdot x_{14}^2 \cdot x_{15}^2$$

One of the forms is numbered equation 100.

$$\sqrt{\sum_{i=1}^{13} x_i^2} = \sqrt{x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2}$$

$$\sqrt{\sum_{i=1}^{13} x_i^2} = \left( x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 + x_7^2 + x_8^2 + x_9^2 + x_{10}^2 + x_{11}^2 + x_{12}^2 + x_{13}^2 \right)^{\frac{1}{2}}$$

Now for an equation array:

$$\begin{aligned} \sum_{i=1}^{13} 2^i &= 2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7 + 2^8 + 2^9 + 2^{10} + 2^{11} + 2^{12} + 2^{13} \\ &= 2 + 4 + 8 + 16 + 32 + 64 + 128 + 256 + 512 + 1024 + 2048 + 4096 + 8192 \\ &= 16382 \end{aligned} \tag{101}$$

$$\begin{aligned} \sum_{i=1}^{13} 2^i &= 2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7 + 2^8 + 2^9 + 2^{10} + 2^{11} + 2^{12} + 2^{13} \\ &= 2 + 4 + 8 + 16 + 32 + 64 + 128 + 256 + 512 + 1024 + 2048 + 4096 + 8192 \\ &= 16382 \quad \text{here is some text in the formula to fill up the line at 12pt font} \end{aligned}$$

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\left|\begin{array}{cc}1&2\\3&4\end{array}\right|&= (1\times 4)-(2\times 3)\\&= 4-6=-2$$

$$\sqrt{a+\sqrt{\frac{b+c+d}{e}}+f}$$

$$\overline{\underline{a}+\overline{b}+\underline{c}+\overline{d}+\overline{\overline{e}}}$$

$$\overbrace{a+\overbrace{b+c+d}^{=0}}^{\text{text}}$$

$$\overset{a}{\longrightarrow}$$

$$\begin{smallmatrix}a\\b\end{smallmatrix}\begin{pmatrix}a\\b\end{pmatrix}$$

$$a+\frac{1}{b+\frac{1}{c+\frac{1}{d+\frac{1}{e+\frac{1}{f+\frac{1}{g+\frac{1}{h}}}}}}}\qquad a+\frac{1}{b+\frac{1}{c+\frac{1}{d+\frac{1}{e+\frac{1}{f+\frac{1}{g+\frac{1}{h}}}}}}}$$

## 2.1 Testing line breaking

$$\begin{array}{l}a=b=c=d=e=f=g=h=i=j=k=l=m=n=o=p=q=r=s=t\\a<b<c<d<e<f<g<h<i<j<k<l<m<n<o<p<q<r<s<t\\a>b>c>d>e>f>g>h>i>j>k>l>m>n>o>p>q>r>s>t\\a\leq b\leq c\leq d\leq e\leq f\leq g\leq h\leq i\leq j\leq k\leq l\leq m\leq n\leq o\leq p\leq q\leq r\leq s\leq t\\a\geq b\geq c\geq d\geq e\geq f\geq g\geq h\geq i\geq j\geq k\geq l\geq m\geq n\geq o\geq p\geq q\geq r\geq s\geq t\end{array}$$

$a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t + u$   
 $a - b - c - d - e - f - g - h - i - j - k - l - m - n - o - p - q - r - s - t - u$   
 $a \times b \times c \times d \times e \times f \times g \times h \times i \times j \times k \times l \times m \times n \times o \times p \times q \times r \times s \times t \times u$   
 $a * b * c * d * e * f * g * h * i * j * k * l * m * n * o * p * q * r * s * t * u * v * w * x * y$   
 $a \cdot b \cdot c \cdot d \cdot e \cdot f \cdot g \cdot h \cdot i \cdot j \cdot k \cdot l \cdot m \cdot n \cdot o \cdot p \cdot q \cdot r \cdot s \cdot t \cdot u \cdot v \cdot w \cdot x \cdot y \cdot z \cdot a \cdot b \cdot c$   
 $a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, a, b, c, d, e, f, g, h, i, j, k, l$

## 2.2 Testing new commands

$$x_1 x^2 x_2$$