

Formulas—a catalogue

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- *A general remark:* `amsart` style or `\usepackage{amsmath}` required

1 Several formulas or sets of displayed conditions

$$(1.1) \quad aaaaaaaaa = b, \quad cc = xxx, \quad dd = yyy,$$

$$(1.2) \quad mmmmmmmmmmmmmmm = 0 \quad \text{for all } i = 1, \dots, n.$$

```
\begin{gather}
aaaaaaaaaa = b, \quad \quad \quad cc = xxx, \quad \quad \quad dd = yyy, \quad \label{E:g1} \\
mmmmmmmmmmmmmm = 0 \quad \quad \quad \text{for all } i=1, \dots, n. \quad \label{E:g2}
\end{gather}
```

$$(1.3) \quad aaaaaaaaa = b, \quad cc = xxx, \quad dd = yyy,$$

$$mmmmmmmmmmmmmmmm = 0 \quad \text{for all } i = 1, \dots, n.$$

```
\begin{gather}
aaaaaaaaaa = b, \quad \quad \quad cc = xxx, \quad \quad \quad dd = yyy, \quad \notag \\
mmmmmmmmmmmmmm = 0 \quad \quad \quad \text{for all } i=1, \dots, n. \quad \label{E:g3}
\end{gather}
```

$$aaaaaaaaaaa = b, \quad cc = xxx, \quad dd = yyy,$$
$$mmmmmmmmmmmmmmmm = 0 \quad \text{for all } i = 1, \dots, n.$$

```
\begin{gather*}
aaaaaaaaaaa = b, \quad \quad \quad cc = xxx, \quad \quad \quad dd = yyy, \\
mmmmmmmmmmmmmm = 0 \quad \quad \quad \text{for all } i=1, \dots, n.
\end{gather*}
```

$$(1.4) \quad \begin{aligned} aaaaaaaaaa &= b, & cc &= xxx, & dd &= yyy, \\ mmmmmmmmmmm &= 0 & \text{for all } i &= 1, \dots, n. \end{aligned}$$

```
\begin{equation} \label{E:g4}
\begin{gathered}
aaaaaaaaaa = b, \quad \quad \quad cc = xxx, \quad \quad \quad dd = yyy, \\
mmmmmmmmmm = 0 \quad \quad \quad \text{for all } i=1, \dots, n.
\end{gathered}
\end{equation}
```

$$(1.5) \quad \begin{aligned} xxxxx &= yyyyyyyyyyyyyy \\ &+ zzzzzzzzzzzzzzzzzz, \end{aligned}$$

$$(1.6) \quad bbb = tttttttttttttttt,$$

$$(1.7) \quad hh = vvvvvvvvvvv.$$

```
\begin{align}
xxxxx &= yyyyyyyyyyyyyy & \label{E:a1} \\
&\quad + zzzzzzzzzzzzzzzzzz, & \notag \\
bbb &= tttttttttttttttt, & \label{E:a2} \\
hh &= vvvvvvvvvvv. & \label{E:a3}
\end{align}
```

$$(1.8) \quad \begin{aligned} xxxxx &= yyyyyyyyyyyyyy \\ &+ zzzzzzzzzzzzzzzzzz, \\ bbb &= tttttttttttttttt, \\ hh &= vvvvvvvvvvv. \end{aligned}$$

```
\begin{equation} \label{E:a4}
\begin{split}
xxxxx &= yyyyyyyyyyyyyy \\
&\quad + zzzzzzzzzzzzzzzzzz, \\
bbb &= tttttttttttttttt, \\
hh &= vvvvvvvvvvv.
\end{split}
\end{equation}
```

$$(1.9) \quad \begin{aligned} aaaaaaaaaaaaaaaaaaaaaaa &= bbbbbbbbbbbb, \\ bbbb &= xxxxxx, \end{aligned}$$

$$(1.10) \quad \begin{aligned} ccccc &= yyyyyyy, \\ ddddddd &= zzzzz. \end{aligned}$$

```
\begin{align}
\begin{split}
aaaaaaaaaaaaaaaaaaaaaa &= bbbbbbbbbbbb, \\
& bbbb &= xxxxxx,
\end{split}
\end{split}\label{E:a5}
\begin{split}
cccc &= yyyyyyy, \\
ddddddd &= zzzzz.\label{E:a6}
\end{split}
\end{align}
```

$$(1.11) \quad \begin{aligned} aaaaaaaaaaaaaaaaaaaaaaa &= bbbbbbbbbbbb, \\ bbbbbbbbbbbbbbbbbbbbbbb &= xxxxxx, \end{aligned}$$

$$(1.12) \quad \begin{aligned} ccccc &= yyyyyyy, \\ ddddddd &= zzzzz. \end{aligned}$$

```
\begin{gather}
\begin{split}
& aaaaaaaaaaaaaaaaaaaaaaa = bbbbbbbbbbbb, \\
& bbbbbbbbbbbbbbbbbbbbbbb = xxxxxx,
\end{split}
\end{gather}\label{E:a7}
\begin{split}
& ccccc = yyyyyyy, \\
& ddddddd = zzzzz.
\end{split}
\end{gather}\label{E:a8}
```

$$\begin{array}{lll} aa = bbb, & dd = ee & \text{(by Lemma 2),} \\ hh = ii, & ll = kkk & \text{(by (1.12)).} \end{array}$$

```
\begin{align*}
aa &= bbb, & dd &= ee & & \text{\text{(by Lemma 2),}} \\
hh &= ii, & ll &= kkk & & \text{\text{(by \eqref{E:a8}).}}
\end{align*}
```

$$(1.13) \quad aa = bbb, \quad dd = ee \quad (\text{by Lemma 2}),$$

$$(1.14) \quad hh = ii, \quad ll = kkk \quad (\text{by (1.12)}).$$

```
\begin{alignat}{3}
aa &=& bbb,\quad\quad\quad & dd &=& ee & & & \& \text{(by Lemma 2),} \quad \label{E:a9} \\
hh &=& ii, & ll &=& kkk\quad\quad\quad & & & \& \text{(by \eqref{E:a8}).} \quad \label{E:a10} \\
\end{alignat}
```

$$(1.15) \quad aa = bbb, \quad dd = ee \quad (\text{by Lemma 2}),$$

$$hh = ii, \quad ll = kkk \quad (\text{by (1.12)}).$$

```
\begin{equation}\label{E:a11}
\begin{alignedat}{3}
aa &=& bbb,\quad\quad\quad & dd &=& ee & & & \& \text{(by Lemma 2),} \\
hh &=& ii, & ll &=& kkk\quad\quad\quad & & & \& \text{(by \eqref{E:a8}).} \\
\end{alignedat}
\end{equation}
```

$$(1.16a) \quad aa = bbb, \quad dd = ee \quad (\text{by Lemma 2}),$$

$$(1.16b) \quad hh = ii, \quad ll = kkk \quad (\text{by (1.12)}).$$

```
\begin{subequations}\label{E:suba}
\begin{alignat}{3}
aa &=& bbb,\quad\quad\quad & dd &=& ee & & & \& \text{(by Lemma 2),} \quad \label{E:suba1} \\
hh &=& ii, & ll &=& kkk\quad\quad\quad & & & \& \text{(by \eqref{E:a8}).} \quad \label{E:suba2} \\
\end{alignat}
\end{subequations}
```

$$(1.17a) \quad aaaaaaaaaaaaaaaaaaaaaaa = bbbbbbbbbbb,$$

$$bbbbbbbbbbbbbbbbbbbbbb = xxxxx,$$

$$(1.17b) \quad ccccc = yyyyyy,$$

$$ddddddd = zzzzz.$$

```
\begin{subequations}\label{E:subg}
\begin{gather}
\begin{split}
& aaaaaaaaaaaaaaaaaaaaaaa = bbbbbbbbbbb, \\
& bbbbbbbbbbbbbbbbbbb = xxxxx, \\
\end{split} \label{E:subg1} \\
\begin{split}
& ccccc = yyyyyy, \\
& ddddddd = zzzzz. \\
\end{split} \label{E:subg2}
\end{gather}
\end{subequations}
```

2 One multiline formula

$$(2.1) \quad \begin{aligned} & aaaaaaaaaaaaaaaaaaaaaaaaaaaaaa \\ & \quad + bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb \\ & \hspace{10em} \leq ddddddddddddddddddddddd. \end{aligned}$$

```
\begin{multiline}\label{E:m1}
aaaaaaaaaaaaaaaaaaaaaaaaaaaaa\
+ bbbbbbbbbbbbbbbbbbbbbbbbbbb\
\le ddddddddddddddddddd.
\end{multiline}
```

$$(2.2) \quad \begin{aligned} & aaaaaaaaaaaaaaaaaaaaaaaaaaaaaa \\ & \quad + bbbbbbbbbbbbbbbbbbbbbbbbbbb + dddddddd - gggggggg \\ & \hspace{10em} \times eeeeeeeeeeeeeeeeeee \\ & \hspace{10em} \leq ddddddddddddddddddd. \end{aligned}$$

```
\begin{multiline}\label{E:m2}
aaaaaaaaaaaaaaaaaaaaaaaaaaaaa\
\shoveleft{+ bbbbbbbbbbbbbbbbbbbbbbb + dddddddd - gggggggg}\
\shoveright{\times eeeeeeeeeeeeeeeeeee}\
\le ddddddddddddddddddd.
\end{multiline}
```

$$(2.3) \quad \begin{aligned} & aaaaaaaaaaaaaaaaa + xxxxxxxxxxx \\ & \hspace{10em} < bbbbbbbbbbbbbbbbbbb \\ & \hspace{10em} + [dddd + eeeee][hhhhhhh - gggggggg] \\ & \hspace{10em} < ccccccccccccccc. \end{aligned}$$

```
\begin{multiline}\label{E:m3}
aaaaaaaaaaaaaaaa + xxxxxxxxxxx\
\begin{aligned}
& < bbbbbbbbbbbbbbbbbbb\
& \quad + [dddd + eeeee][hhhhhhh - gggggggg]\
& < ccccccccccccccc.
\end{aligned}
\end{multiline}
```

$$(2.4) \quad \text{Pascal}_3 = \begin{array}{c} 1 \\ 1 \ 2 \ 1 \\ 1 \ 3 \ 3 \ 1 \end{array}$$

```
\begin{equation}\label{E:pasc}
\mathrm{Pascal}_{3} = \begin{gathered}
1\\
1\ 2\ 1\\
1\ 3\ 3\ 1
\end{gathered}
\end{equation}
```

$$\begin{array}{ccc} & & 1 \\ & 1 & 1 \ 2 \ 1 \\ 1 \ 2 \ 1 & & 1 \ 3 \ 3 \ 1 \end{array}$$

```
\begin{equation*}
\begin{gathered}[b]
1\\
1\ 2\ 1
\end{gathered}
\quad
\begin{gathered}[b]
1\\
1\ 2\ 1\\
1\ 3\ 3\ 1
\end{gathered}
\end{equation*}
```

$$\begin{array}{ccc} & 1 & 1 \\ 1 \ 2 \ 1 & & 1 \ 2 \ 1 \\ & & 1 \ 3 \ 3 \ 1 \end{array}$$

```
\begin{equation*}
\begin{gathered}[t]
1\\
1\ 2\ 1
\end{gathered}
\quad
\begin{gathered}[t]
1\\
1\ 2\ 1\\
1\ 3\ 3\ 1
\end{gathered}
\end{equation*}
```

$$(2.5) \quad A = zt = ztuv + [f_1(a, b, c, d, e, f, g, h), \\ f_2(a, b, c, d, e, f, g, h), \\ f_3(a, b, c, d, e, f, g, h)] \\ = cccccccccccccc$$

```
\begin{align}\label{E:top}
A &= \begin{aligned}[t]
      zt = ztuv + [f_1(a,b,c,d,e,f,g,h),\ \\
                  &f_2(a,b,c,d,e,f,g,h),\ \\
                  &f_3(a,b,c,d,e,f,g,h)]
    \end{aligned}\ \\
&= cccccccccccccc\notag
\end{align}
```

$$xxxxxx + [f_1(a, b, c, d, e, f, g, h), \\ f_2(a, b, c, d, e, f, g, h), \\ f_3(a, b, c, d, e, f, g, h)] = ttttttttttttttttttttt \\ = bbbbbbbbbbbbbbb.$$

```
\begin{align*}
\begin{aligned}[b]
xxxxxxx + [f_1(a,b,c,d,e,f,g,h),\ \\
           &f_2(a,b,c,d,e,f,g,h),\ \\
           &f_3(a,b,c,d,e,f,g,h)]
\end{aligned}
&= ttttttttttttttttttttt\ \\
&= bbbbbbbbbbbbbbb.
\end{align*}
```

$$(2.6) \quad xxxx = yyyyyyyyyyyyyy + [eeee \\ \times zzzzzzzzzzzzzzzzzzz] \\ = ttttttttttttttt \\ = vvvvvvvvvvv.$$

```
\begin{align}\label{E:shove}
xxxxx &= \begin{aligned}[t]
      yyyyyyyyyyyyyy + [eeee\ \\
                        &\times zzzzzzzzzzzzzzzzzzz]
    \end{aligned}\ \\
&= tttttttttttttttt \notag\ \\
&= vvvvvvvvvvv.\notag
\end{align}
```

$$(2.7) \quad \begin{aligned} xxxxx &= yyyyyyyyyyyyyyy + [eeee \\ &\quad \times zzzzzzzzzzzzzzzzzz] \end{aligned}$$

(note that we have not used the full strength of (H) here, but only the concavity of f)

$$\begin{aligned} &= tttttttttttttttt \\ &= vvvvvvvvvvv. \end{aligned}$$

```
\begin{align}
xxxxx &= \begin{aligned}[t]
& yyyyyyyyyyyyyyy + [&eeee \quad \backslash \\
& \quad \quad \quad \backslash \times zzzzzzzzzzzzzzzzzz] \\
& \end{aligned} \backslash \label{E:inter} \quad \backslash \\
\intertext{\(\emph{note that we have not used the full strength} \\
of \$(H)\$ here, but only the concavity of \$(f)\$)} \\
& \quad \quad \quad \backslash = tttttttttttttttt \quad \backslash \text{notag} \\
& \quad \quad \quad \backslash = vvvvvvvvvvv. \backslash \text{notag} \\
\end{align}
```

3 Using macros

$$\left(\frac{1}{2}(u+v)\right)^2 = \frac{u + \frac{v+z}{g+rh}}{n+1} + \left(\prod_{i=1}^n A_i\right)^2 + \left(\frac{u}{v}\right)^n.$$

```
\[
\bigl(\tfrac{1}{2}(u+v)\bigr)^2
= \frac{u + \dfrac{v+z}{g+rh}}{n+1}
+ \Bigl(\prod_{i=1}^n A_i\Bigr)^2
+ \biggl(\frac{u}{v}\biggr)^n.
\]
```

$$(C) \quad f(x) \stackrel{\alpha}{=} \begin{cases} \sqrt[3]{2/\sin x} & \text{if } x \in (0, \pi), \\ 0 & \text{otherwise.} \end{cases}$$

```
\[
f(x)\overset{\alpha}{=}
\begin{cases}
\sqrt[3]{2/\sin x} & \text{\textit{if } \$x \in (0, \pi)\$,} \\
0 & \text{\textit{otherwise.}}
\end{cases}
\end{cases}
\tag{C}
\]
```


$$\mathbb{A} \xrightarrow{a+b+c+d} \mathbf{B} \xrightarrow[abc]{\mathcal{C} \square \mathbf{D}} \text{gdeg } E.$$

Macros:

```
\usepackage{amssymb}
\newcommand{\arr}{\xrightarrow}
\newcommand{\ssquare}{\mathbin{\square}}
\newcommand{\bA}{\mathbb{A}}
\newcommand{\BB}{\mathbf{B}}
\newcommand{\frC}{\mathfrak{C}}
\newcommand{\biD}{\boldsymbol{D}}
\DeclareMathOperator{\gdeg}{\text{gdeg}}
```

Code:

```
\[
\bA \arr{a+b+c+d} \BB \arr[abc]{} \frC \ssquare \biD \arr{d^2} \gdeg E.
\]
```

$$\sum'_{k < m, l < n} \binom{m+n}{k+l} = \prod_{\substack{k+l+m=3 \\ 2k-l+n \leq 7}} a_{kl}$$

Macros:

```
\newcommand{\prsum}{\sideset{}{\'}\sum}
\newcommand{\dprod}{\operatorname*\prod}
```

Code:

```
\prsum_{k < m, \, l < n} \binom{m+n}{k+l}
= \dprod_{\substack{k+l+m=3 \\ 2k-l+n \le 7}} a_{kl}
```

$$w^* \text{-}\lim_{n \rightarrow \infty} a_n = \begin{pmatrix} \langle a, b \rangle & \langle a, c \rangle \\ \langle c, a \rangle & \langle b, c \rangle \end{pmatrix}$$

Macros:

```
\newcommand{\wstlim}{\mathop{w^*}\textup{-}\lim}
\def\langle#1\rangle{\langle#1\rangle}
```

Code:

```
\[
\wstlim_{n \to \infty} a_n =
\begin{pmatrix}
\langle a, b \rangle & \langle a, c \rangle \\
\langle c, a \rangle & \langle b, c \rangle
\end{pmatrix}
\]
```