Using Keystrokes to Write Equations
In Microsoft Office 2007 Equation Editor

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I. Introduction and Ground Rules

A. Special features of Equation Editor include:

a) Implementation of mathematics markup language called Office Math Markup Languange (OMML). This minimizes switching between keyboard and mouse.

b) Font size in equations can be changed using the main menu items.

B. Special notations used in this document.

We will use the following characters to denote special key combinations:

Space key	**[SP]**
Left cursor key	←
Right cursor key	→
Alt-Equals combination	**[Alt=]**

Also, since the string of keystrokes will be long, the key-in sequences may be shown in the multiple lines.

C. In-line vs off-line modes.

To enter the Equation Editor mode, either key-in **[Alt=]** or select the **[Insert]→[Equation]** menu item:

a) If **[Alt=]** is implemented inside a document paragraph, then the equation is known as "in-line" equation mode.

Example:

" If we have $x_{init} \leq \frac{y}{4}$, the system will…"

b) If **[Alt=]** is implemented at a separate line (no attached text before or after the equation), then the result is on the "off-line" mode and will be centered automatically.

Example:
" If we have

$$x_{init} \leq \frac{y}{4}$$

the system will…"

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In this tutorial document, we will be exclusively using the "off-line" mode.

II.   Greek letters, Special Symbols and Other Fonts

Syntax Code: For key sequences that start with a backslash ("\"), e.g. **\alpha**, you need to tap the spacebar once (shown as **[SP]** below) to change the appearance.

Try the following inside the Equation Building box:

Key-in sequence: **\alpha[SP]+ \beta[SP] +-\ell[SP]**

Result:

$$\alpha + \beta \pm \ell$$

- Table 1 contains the character maps for Greek letters. Table 2a contains the character maps for special symbols.

- Hollow-thickened fonts can be obtained by prefix of **\double**

   Key-in sequence: **\doubleM+\doubleh[SP]**

   Result: $\mathbb{M} + \mathbb{h}$
- Script fonts can be obtained by prefix of **\script**

   Key-in sequence: **\scriptM+\scripth [SP]**

   Result: $\mathcal{M} + \hbar$

- "fraktur" fonts can be obtained by prefix of **\fraktur** (see Table 2b).

   Key-in sequence: **\frakturM\div\frakturh[SP]**

   Result: $\mathfrak{M} \div \mathfrak{h}$

III. Subscripts and Superscripts

Syntax Code:

a) For subscripts, type underscore ("_") followed by the subscript string, then tap the spacebar once.

> **Key-in Sequence:** \alpha_4[SP]
> **Result:**
>
> $$\alpha_4$$

b) For superscripts, type caret ("^") followed by the superscript string, then tap the spacebar once.

> **Key-in Sequence:** \beta^final[SP]
> **Result:**
>
> $$\beta^{final}$$

> **Key-in Sequence:** T_init^2[SP]
>
> **Result:**
>
> $$T_{init}^2$$

> **Key-in Sequence:** (_A^B)[SP]←\Omega[SP]→+2
>
> **Result:**
>
> $$_A^B\Omega + 2$$

IV.   Accents and Text Mode

a) For accents, type the letter first then followed by accent codes given in Table 3. You need to tap the spacebar <u>twice</u> to move the accent above (or in some cases below) the letters.

Key-in Sequence: **p\check[SP][SP]_0[SP]**
Result:

$$\check{p}_0$$

b) To include strings to appear in text mode inside an equation, enclose the text strings by double quotes, then tap the spacebar.

Key-in Sequence:
                x\tilde[SP][SP] \searrow[SP]y\ddot[SP][SP]
            [SP][SP][SP]"only if"[SP][SP] [SP][SP]t\leq[SP]10
Result:

$$\tilde{x} \searrow \ddot{y} \quad \text{only if} \quad t \leq 10$$

V.   <u>Fractions</u>

Syntax Code: Type numerator string entry, then key-in a slash ("/"), followed by the denominator string entry. Then tap spacebar to change the appearance. Note: Group the numerator and denominator strings by parentheses.

Key-in Sequence: **(3+T^2)/(x_1+1/4[SP])[SP][SP]**
Result:

$$\frac{3 + T^2}{x_1 + \dfrac{1}{4}}$$

Tip: An alternative is to use the sequence: **[SP]/[SP]** to obtain fraction placeholders. Then you can fill the placeholders by using the cursor keys.

VI. Square Roots and n^{th} Roots

Syntax Code:

a) For square roots, key-in **\sqrt** followed by a group of terms enclosed by parentheses. Then tap spacebar to change the appearance.

Key-in Sequence:
$$\text{\textbackslash sqrt(4+(d\^{}2[SP]x)/(dt\^{}2[SP])[SP])[SP]}$$

Result:

$$\sqrt{4 + \frac{d^2 x}{dt^2}}$$

b) For the cube root and quad root, use **\cbrt** and **\qdrt**, respectively,

Key-in Sequence:
$$\text{\textbackslash cbrt(4+(d\^{}2[SP]x)/(dt\^{}2[SP])[SP])[SP]+\textbackslash qdrt(xyz)[SP]}$$

Result:

$$\sqrt[3]{4 + \frac{d^2 x}{dt^2}} + \sqrt[4]{xyz}$$

c) For the nth root, you need to input the degree and radicand separated by ampersand (&).

Key-in Sequence:
$$\text{\textbackslash sqrt(10\&x\^{}2[SP]+y\^{}2[SP]) [SP]}$$

Result:

$$\sqrt[10]{x^2 + y^2}$$

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VII. Integrals, Summations and other Series Operators

Syntax Code: Type operator codes given in Table 4. Use underscore (_) for lower limit and caret (^) for upper limit. Then tap spacebar to get placeholder.

Key-in Sequence:
   \int_0^\infty[SP][SP]2/\sqrt(1+x^2[SP])[SP][SP]dx

Result:

$$\int_0^\infty \frac{2}{\sqrt{1+x^2}} dx$$

Key-in Sequence:
   \sum_(i=0)^N[SP](dx_i[SP])/dt[SP]

Result:

$$\sum_{i=0}^N \frac{dx_i}{dt}$$

VIII. <u>Brackets</u>

Syntax Code: Enclose the group of terms to be bracketed using the chosen pair of left and right symbols from Table 5. Move cursor to the right of the right enclosing symbol and tap the spacebar to automatically resize the brackets.

Key-in Sequence:
$$\{1+x/y[SP]\}^\wedge(1/4[SP])[SP]$$

Result:

$$\left\{1+\frac{x}{y}\right\}^{\frac{1}{4}}$$

Note: since parentheses are also used as grouping markers, it may disappear automatically as shown in the example above. If you need the parentheses then enclose the terms with another parentheses pair.

Key-in Sequence:
$$\{1+x/y[SP]\}^\wedge((-1/4[SP]))[SP]$$

Result:

$$\left\{1+\frac{x}{y}\right\}^{\left(-\frac{1}{4}\right)}$$

Note: Combination of pairs are possible with **\open** and **\close** marks as invisible partners.

Key-in Sequence:
$$\backslash open[SP](d^\wedge3[SP]f)/(dt^\wedge3)[SP]$$
$$|\_(t=0)[SP]$$

Result:

$$\left.\frac{d^3f}{dt^3}\right|_{t=0}$$

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Key-in Sequence:

\bra[SP]\open[SP]
x^2[SP]+y^2[SP]
|z\tilde[SP][SP]/2[SP]
\close[SP]\ket [SP]

Result:

$$\left\langle x^2 + y^2 \middle| \frac{\tilde{z}}{2} \right\rangle$$

IX. <u>Matrices</u>

Syntax Code: Key-in **\matrix** followed by a group of elements that are enclosed by a parenthesis and then tap spacebar to change appearance. The row elements are delimited by &'s and columns are delimited by @'s. (Refer to previous section on the choice for brackets).

Key-in Sequence:
$$A=(\backslash matrix(1\&2@3\&4))[SP]$$

Result:

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

Key-in Sequence:
$$\backslash sum\_\backslash matrix(i=1,\backslash ldots,10@j>i)[SP]$$
$$A\_ij[SP]$$

Result:

$$\sum_{\substack{i=1,\dots,10 \\ j>i}} A_{ij}$$

Tips: When building larger or complicated matrices, it is often more efficient to set placeholders for the elements of the array, and then use the cursor to locate the specific element to be filled.

This can be done by entering a string of $(n-1)$ @'s and $(m-1)$ &'s, where n is the number of rows and m is the number of columns.

For example, the key-in sequence **(\matrix(@@&&&&))[SP]** should create a 3 by 5 matrix ready for input.

For conditional statements you can use the left curly bracket and the \close bracket.

Key-in Sequence:

> H(t)={\matrix(
> 0 &" if "[SP]t\le[SP]0@@
> 1&"otherwise"
>)[SP]\close[SP]

Result:

$$H(t) = \begin{cases} 0 & \text{if } t \le 0 \\ 1 & \text{otherwise} \end{cases}$$

Note: you may need to right-click at the element to change matrix alignments.

X. <u>**Overbraces and Underbraces**</u>

Syntax Code: Use horizontal brace symbols given in Table 6 followed by the string of terms that are enclosed by a parenthesis and then tap spacebar to change appearance.

Key-in Sequence:
$$\text{\textbackslash overbrace(x\^{}2+y\^{}2[SP])[SP]}$$

Result:

$$\overbrace{x^2 + y^2}$$

To include other entries, such as labels, above or below the braces, use **\above** or **\below** keywords followed by the string of terms enclosed by a parenthesis and then tap spacebar to change the appearance.

Key-in Sequence:
$$\text{y+z+}$$
$$\text{\textbackslash underbrace(xy+dx/dt[SP])[SP]}$$
$$\text{\textbackslash below(``very sensitive to noise''[SP])[SP]}$$
$$\text{= 0}$$

Result:

$$y + z + \underbrace{xy + \frac{dy}{dt}}_{\text{very sensitive to noise}} = 0$$

Key-in Sequence:
$$\text{(A+B\textbackslash rightarrow[SP]\textbackslash below[SP]}$$
$$\text{(\textbackslash inc[SP]H=30'' kcal/mole''[SP])[SP]}$$
$$\text{P+C}$$

Result:

$$A + B \xrightarrow[\Delta H = 30 \text{ kcal/mole}]{} P + C$$
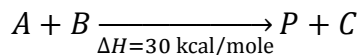
Note: For double overbars and double underbars, one can use the accent symbols: **\Bar** and **\Ubar**, respectively. (see section III for more details.)

Key-in Sequence:

(x^2+y^2[SP])\Bar[SP][SP]

Result:

$$\overline{\overline{x^2 + y^2}}$$

XI. <u>Functions</u>

Syntax Code: Enter the functions given in Table 7, and the letters will change automatically to text mode. For some functions such as **max**, **min**, **sup**, **inf** and **lim**, the subscripts should be grouped by a parenthesis and followed by a spacebar tap, will place the entries underneath the function.

Key-in Sequence:
<div align="center">

lim_(t->\infty)[SP]
(3[SP]sin (2\pi\omega[SP]t))

</div>

Result:

$$\lim_{t\to\infty}(3\sin(2\pi\omega t))$$

XII. <u>Additional Tips</u>

1. Adding some space above to have larger brackets

- Add **\above** keyword.

Key-in Sequence:
<div align="center">

lim_(t->\infty)[SP]
(3[SP]sin (2\pi\omega[SP]t)\above[SP])

</div>

Result:

$$\lim_{t\to\infty}\left(3\sin(2\pi\omega t)\right)$$

2. Multiple equations

- use **[shift-ENTER]** key combination instead of enter.
- to center the equations at the "=" sign, select only the equation group, then **[right-click]** and select the **[Align at =]** item.

Table 1. Greek Symbols

\alpha	α	\iota	ι	\varrho	ϱ
\beta	β	\kappa	κ	\sigma	σ
\gamma	γ	\lambda	λ	\varsigma	ς
\delta	δ	\mu	μ	\tau	τ
\epsilon	ϵ	\nu	ν	\upsilon	υ
\varepsilon	ε	\xi	ξ	\phi	ϕ
\zeta	ζ			\varphi	φ
\eta	η	\pi	π	\chi	χ
\theta	θ	\varpi	ϖ	\psi	ψ
\vartheta	ϑ	\rho	ρ	\omega	ω

\Gamma	Γ	\Xi	Ξ	\Phi	Φ
\Delta	Δ	\Pi	Π	\Psi	Ψ
\Theta	Θ	\Sigma	Σ	\Omega	Ω
\Lambda	Λ	\Upsilon	Υ		

Table 2a. Special Symbols

+-	$\pm$	\rightarrow	$\rightarrow$	\angle	$\angle$
-+	$\mp$	\leftarrow	$\leftarrow$	\propto	$\propto$
\infty	∞	\uparrow	$\uparrow$	\gg	$\gg$
\degree	$^\circ$	\downarrow	$\downarrow$	\ll	$\ll$
\ell	ℓ	\nwarrow	$\nwarrow$	\ge	$\geq$
\hbar	$\hbar$	\nearrow	$\nearrow$	\le	$\leq$
\partial	∂	\searrow	$\searrow$	\succ	$\succ$
\inc	Δ	\swarrow	$\swarrow$	\succeq	$\succeq$
\nabla	∇	\leftrightarrow	$\leftrightarrow$	\prec	$\prec$
\forall	$\forall$	\mapsto	$\mapsto$	\preceq	$\preceq$
\exists	$\exists$	\models	$\models$	\div	$\div$
\in	$\in$	\Rightarrow	$\Rightarrow$	\times	$\times$
\ni	$\ni$	\Leftarrow	$\Leftarrow$	\circ	$\circ$
\notelement	$\notin$	\Leftrightarrow	$\Leftrightarrow$	\star	$\star$
\notcontain	$\not\ni$	\leftharpoonup	$\leftharpoonup$	\cdot	$\cdot$
\therefore	$\therefore$	\rightharpoonup	$\rightharpoonup$	\bullet	$\bullet$
\because	$\because$	\leftharpoondown	$\leftharpoondown$	\oplus	$\oplus$
\emptyset	$\emptyset$	\rightharpoondown	$\rightharpoondown$	\otimes	$\otimes$
\subset	$\subset$	\hookleftarrow	$\hookleftarrow$	\odot	$\odot$
\subseteq	$\subseteq$	\hookrightarrow	$\hookrightarrow$	\ominus	$\ominus$
\superset	$\supset$	\uparrow	$\uparrow$	\uplus	$\uplus$
\superseteq	$\supseteq$	\downarrow	$\downarrow$	\aleph	$\aleph$
\sqsubseteq	$\sqsubseteq$	\updownarrow	$\updownarrow$	\bet	$\beth$
\sqsuperseteq	$\sqsupseteq$	\Uparrow	$\Uparrow$	\dalet	$\daleth$
\cap	$\cap$	\Downarrow	$\Downarrow$	\gimbel	$\gimel$
\cup	$\cup$	\Updownarrow	$\Updownarrow$	\wp	$\wp$
\sqcap	$\sqcap$	\smash	$\updownarrow$	\box	$\Box$
\sqcup	$\sqcup$	\asmash	$\uparrow$	\rect	$\Box$
\wedge	$\wedge$	\neq	$\neq$	\bowtie	$\bowtie$
\vee	$\vee$	\sim	$\sim$	\phantom	$\diamondsuit$
\cdots	$\cdots$	\simeq	$\simeq$	\diamondsuit	$\diamondsuit$
\ldots	$\ldots$	\approx	$\approx$	\clubsuit	$\clubsuit$
\vdots	$\vdots$	\cong	$\cong$	\spadesuit	$\spadesuit$
\ddots	$\ddots$	\asymp	$\asymp$	\heartsuit	$\heartsuit$
\rddots	$\iddots$	\equiv	$\equiv$		
\ratio	$:$	\doteq	$\doteq$		

Table 2b. "Fraktur" Fonts
(prefix the letter by **\fraktur**, e.g. **\frakturg[SP]** yields 𝔤 .**)**

a	𝔄		n	𝔑
b	𝔅		o	𝔒
c	ℭ		p	𝔓
d	𝔇		q	𝔔
e	𝔈		r	ℜ
f	𝔉		s	𝔖
g	𝔊		t	𝔗
h	ℌ		u	𝔘
i	ℑ		v	𝔙
j	𝔍		w	𝔚
k	𝔎		x	𝔛
l	𝔏		y	𝔜
m	𝔐		z	ℨ

Table 3. Accent Symbols.

(**Note:** you need to hit spacebar twice to change the appearance)

\tilde	$\tilde{p}$	**\check**	$\check{p}$
\hat	$\hat{p}$	**\acute**	$\acute{p}$
\breve	$\breve{p}$	**\grave**	$\grave{p}$
\dot	$\dot{p}$	**\bar**	$\bar{p}$
\ddot	$\ddot{p}$	**\Bar**	$\bar{\bar{p}}$
\dddot	$\dddot{p}$	**\ubar**	$\underline{p}$
\prime	p'	**\Ubar**	$\underline{\underline{p}}$
\pprime	p''	**\vec**	$\vec{p}$
\ppprime	p'''		

Table 4. Integrals and Series Operator Symbols.

\int	$\displaystyle\int_a^b$	\sum	$\displaystyle\sum_{i=0}^{\infty}$
\iint	$\displaystyle\iint_A$	\prod	$\displaystyle\prod_{i=1}^{N}$
\iiint	$\displaystyle\iiint_V$	\coprod	$\displaystyle\coprod_{i=1}^{N}$
\oint	$\displaystyle\oint_C$	\bigcup	$\displaystyle\bigcup_{i=1}^{M}$
\oiiint	$\displaystyle\oiint_S$	\bigcap	$\displaystyle\bigcap_{k=-3}^{3}$
\oiiint	$\displaystyle\oiiint_V$	\bigvee	$\displaystyle\bigvee_{j=k}^{N}$
		\bigwedge	$\displaystyle\bigwedge_{i=0}^{\infty}$
\bigoplus	$\displaystyle\bigoplus_{i=1}^{P}$	\biguplus	$\displaystyle\biguplus_{k=1}^{M}$
\bigodot	$\displaystyle\bigodot_{i=1}^{N}$	\bigotimes	$\displaystyle\bigotimes_{i=1}^{M}$

Table 5. Bracket Symbols.
(**Note:** first column is for left symbols while the
second column is for the right symbols.)

(	)	$\left(\dfrac{1}{2}\right)$
[	]	$\left[\dfrac{1}{2}\right]$
{	}	$\left\{\dfrac{1}{2}\right\}$
|	|	$\left|\dfrac{1}{2}\right|$
\norm	\norm	$\left\|\dfrac{1}{2}\right\|$
\bra	\ket	$\left\langle\dfrac{1}{2}\right\rangle$
\lfloor	\rfloor	$\left\lfloor\dfrac{1}{2}\right\rfloor$
\lceil	\rceil	$\left\lceil\dfrac{1}{2}\right\rceil$
\open	\close	$\dfrac{1}{2}$

Table 6. Horizontal Braces.

\overbar	$\overline{x+y}$	\underbar	$\underline{x+y}$
\overbrace	$\overbrace{x+y}$	\underbrace	$\underbrace{x+y}$
\overparen	$\overparen{x+y}$	\underparen	$\underparen{x+y}$

Table 7a. Trigonometric Functions
(Each below can be prefixed by **a** or **arc**, and/or suffixed by **h**, e.g. **arcsinh**)

sin	csc
cos	sec
tan	cot

Table 7b. Other Functions

arg	erf	inf	log
def	exp	lg	max
deg	gcd	lim	min
dim	hom	ln	Pr