How various formats can deal with LaTeX math

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This document is translated to the format **pdflatex**. The purpose is to test LaTeX math in DocOnce with various output formats.

Test 1: Inline math. We can get an inline equation `$u(t)=e^{-at}$` rendered as $u(t) = e^{-at}$.

Test 2: A single equation with label. An equation with number,

```
!bt
\begin{equation} u(t)=e^{-at} label{eq1a}\end{equation}
!et
```

looks like

$$u(t) = e^{-at} \tag{1}$$

Maybe this multi-line version is what we actually prefer to write:

```
!bt
\begin{equation}
u(t)=e^{-at}
label{eq1b}
\end{equation}
!et
```

The result is the same:

$$u(t) = e^{-at} \tag{2}$$

We can refer to this equation through its label `eq1b`: (2).

Test 3: Multiple, aligned equations without label and number. MathJax has historically had some problems with rendering many LaTeX math environments, but the `align*` and `align` environments have always worked.

```
!bt
\begin{align*}
u(t)&=e^{-at}\\
v(t) - 1 &= \frac{du}{dt}
\end{align*}
!et
```

Result:

$$\begin{aligned} u(t) &= e^{-at} \\ v(t) - 1 &= \frac{du}{dt} \end{aligned}$$

Test 4: Multiple, aligned equations with label. Here, we use `align` with user-prescribed labels:

```
!bt
\begin{align}
u(t)&=e^{-at}
label{eq2b}\\
v(t) - 1 &= \frac{du}{dt}
label{eq3b}
\end{align}
!et
```

Result:

$$u(t) = e^{-at} \tag{3}$$

$$v(t) - 1 = \frac{du}{dt} \tag{4}$$

We can refer to the last equations as the system (3)-(4).

Test 5: Multiple, aligned equations without label. In LaTeX, equations within an `align` environment is automatically given numbers. To ensure that an HTML document with MathJax gets the same equation numbers as its LaTeX companion, DocOnce generates labels in equations where there is no label prescribed. For example,

```
!bt
\begin{align}
u(t)&=e^{-at}
\\
v(t) - 1 &= \frac{du}{dt}
\end{align}
!et
```

is edited to something like

```
!bt
\begin{align}
u(t)&=e^{-at}
label{_auto5}\\
v(t) - 1 &= \frac{du}{dt}
label{_auto6}
\end{align}
!et
```

and the HTML output gets the two equation numbered.

$$
\begin{align}
u(t) &= e^{-at} \tag{5}\\
v(t) - 1 &= \frac{du}{dt} \tag{6}
\end{align}
$$

Test 6: Multiple, aligned equations with multiple alignments. The `align` environment can be used with two `&` alignment characters, e.g.,

```
!bt
\begin{align}
\frac{\partial u}{\partial t} &= \nabla^2 u, & x\in (0,L),
\ t\in (0,T]\\
u(0,t) &= u_0(x), & x\in [0,L]
\end{align}
!et
```

The result becomes

$$
\begin{align}
\frac{\partial u}{\partial t} &= \nabla^2 u, & x\in (0,L),\ t\in (0,T] \tag{7}\\
u(0,t) &= u_0(x), & x\in [0,L] \tag{8}
\end{align}
$$

A better solution is usually to use an `alignat` environment:

```
!bt
\begin{alignat}{2}
\frac{\partial u}{\partial t} &= \nabla^2 u, & x\in (0,L),
\ t\in (0,T]\\
u(0,t) &= u_0(x), & x\in [0,L]
\end{alignat}
!et
```

with the rendered result

$$
\begin{alignat}{2}
\frac{\partial u}{\partial t} &= \nabla^2 u, \ & x\in (0,L),\ t\in (0,T] \tag{9}\\
u(0,t) &= u_0(x), & x\in [0,L] \tag{10}
\end{alignat}
$$

Test 7: Multiple, aligned eqnarray equations without label. Let us try the old `eqnarray*` environment.

```
!bt
\begin{eqnarray*}
u(t)&=& e^{-at}\\
v(t) - 1 &=& \frac{du}{dt}
\end{eqnarray*}
!et
```

and results in

$$\begin{aligned} u(t) &= e^{-at} \\ v(t) - 1 &= \frac{du}{dt} \end{aligned}$$

Test 8: Multiple, eqnarrayed equations with label. Here use `eqnarray` with labels:

```
!bt
\begin{eqnarray}
u(t)&=& e^{-at}
label{eq2c}\\
v(t) - 1 &=& \frac{du}{dt}
label{eq3c}
\end{eqnarray}
!et
```

and results in

$$u(t) = e^{-at} \quad (11)$$

$$v(t) - 1 = \frac{du}{dt} \quad (12)$$

Can we refer to the last equations as the system (11)-(12) in the pdflatex format?

Test 9: The `multiline` environment with label and number. The LaTeX code

```
!bt
\begin{multline}
\int_a^b f(x)dx = \sum_{j=0}^{n} \frac{1}{2} h(f(a+jh) +
f(a+(j+1)h)) \\
=\frac{h}{2}f(a) + \frac{h}{2}f(b) + \sum_{j=1}^n f(a+jh)
label{multiline:eq1}
\end{multline}
!et
```

gets rendered as

$$\begin{aligned}\int_a^b f(x)dx = \sum_{j=0}^{n} \frac{1}{2} h(f(a+jh) + f(a+(j+1)h)) \\ = \frac{h}{2}f(a) + \frac{h}{2}f(b) + \sum_{j=1}^n f(a+jh) \qquad (13)\end{aligned}$$

and we can hopefully refer to the Trapezoidal rule as the formula (13).

Test 10: Splitting equations using `split`. Although `align` can be used to split too long equations, a more obvious command is `split`:

```
!bt
\begin{equation}
\begin{split}
\int_a^b f(x)dx = \sum_{j=0}^{n} \frac{1}{2} h(f(a+jh) +
f(a+(j+1)h)) \\
=\frac{h}{2}f(a) + \frac{h}{2}f(b) + \sum_{j=1}^n f(a+jh)
\end{split}
\end{equation}
!et
```

The result becomes

$$\begin{split}\int_a^b f(x)dx = \sum_{j=0}^{n} \frac{1}{2} h(f(a+jh) + f(a+(j+1)h)) \\ = \frac{h}{2}f(a) + \frac{h}{2}f(b) + \sum_{j=1}^n f(a+jh)\end{split} \tag{14}$$

Test 11: Newcommands and boldface bm vs pmb. We have

$$\frac{\partial\boldsymbol{u}}{\partial t} + \nabla\cdot\nabla\boldsymbol{u} = \nu\nabla^2\boldsymbol{u} - \frac{1}{\varrho}\nabla p,$$

and $\nabla\boldsymbol{u}(\boldsymbol{x})\cdot\boldsymbol{n}$ with plain old pmb. Here are the same formulas using `\bm`:

$$\frac{\partial\boldsymbol{u}}{\partial t} + \nabla\cdot\nabla\boldsymbol{u} = \nu\nabla^2\boldsymbol{u} - \frac{1}{\varrho}\nabla p,$$

and $\nabla\boldsymbol{u}(\boldsymbol{x})\cdot\boldsymbol{n}$.