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# A Sample Document

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## Abstract

This is a sample input file. Comparing it with the output it generates can show you how to produce a simple document of your own.

**Keywords:** sample, L<sup>A</sup>T<sub>E</sub>X.

## 1 Normal Text

The ends of words and sentences are marked by spaces. It doesn't matter how many spaces you type; one is as good as 100. The end of a line counts as a space.

One or more blank lines denote the end of a paragraph.

Since any number of consecutive spaces are treated like a single one, the formatting of the input file makes no difference to T<sub>E</sub>X, but it makes a difference to you. When you use L<sup>A</sup>T<sub>E</sub>X, making your input file as easy to read as possible will be a great help as you write your document and when you change it. This sample file shows how you can add comments to your own input file.

Because printing is different from typewriting, there are a number of things that you have to do differently when preparing an input file than if you were just typing the document directly. Quotation marks like “this” have to be handled specially, as do quotes within quotes: “ ‘this’ is what I just wrote, not ‘that’ ”.

Dashes come in three sizes: an intra-word dash, a medium dash for number ranges like 1–2, and a punctuation dash—like this.

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A sentence-ending space should be larger than the space between words within a sentence. You sometimes have to type special commands in conjunction with punctuation characters to get this right, as in the following sentence. Gnats, gnus, etc. all begin with G. You should check the spaces after periods when reading your output to make sure you haven't forgotten any special cases. Generating an ellipsis ... with the right spacing around the periods requires a special command.

T<sub>E</sub>X interprets some common characters as commands, so you must type special commands to generate them. These characters include the following: \$ & % # { and }.

In printing, text is emphasized by using an *italic* type style.

*A long segment of text can also be emphasized in this way. Text within such a segment given additional emphasis with Roman type. Italic type loses its ability to emphasize and become simply distracting when used excessively.*

It is sometimes necessary to prevent T<sub>E</sub>X from breaking a line where it might otherwise do so. This may be at a space, as between the “Mr.” and “Jones” in “Mr. Jones”, or within a word—especially when the word is a symbol like *itemnum* that makes little sense when hyphenated across lines.

T<sub>E</sub>X is good at typesetting mathematical formulas like  $x - 3y = 7$  or  $a_1 > x^{2n}/y^{2n} > x'$ . Remember that a letter like  $x$  is a formula when it denotes a mathematical symbol, and should be treated as one.

## 2 Notes

Footnotes<sup>1</sup> pose no problem.<sup>2</sup>

## 3 Displayed Text

The following is an example of an *itemized* list.

- This is the first item of an itemized list. Each item in the list is marked with a “tick”. The document style determines what kind of tick mark is used.
- This is the second item of the list. It contains another list nested inside it. The inner list is an *enumerated* list.

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<sup>1</sup> This is an example of a footnote.

<sup>2</sup> And another one.

1. This is the first item of an enumerated list that is nested within the itemized list.
2. This is the second item of the inner list.  $\text{\LaTeX}$  allows you to nest lists deeper than you really should.

This is the rest of the second item of the outer list. It is no more interesting than any other part of the item.

- This is the third item of the list.

The following is an example of an *enumerated* list, two levels deep.

1. This is the first item of an enumerated list. Each item in the list is marked with a letter or number. The document style determines what kind of mark is used.
2. This is the second item of the list. It contains another enumerated list nested inside it.
  - (a) This is the first item of an enumerated list that is nested within the enumerated list.
  - (b) This is the second item of the inner list.  $\text{\LaTeX}$  allows you to nest lists deeper than you really should.

This is the rest of the second item of the outer list. It is no more interesting than any other part of the item.

3. This is the third item of the list.

The following is an example of a *description* list.

**Cow** Highly intelligent animal that can produce milk out of grass.

**Horse** Less intelligent animal renowned for its legs.

**Human being** Not so intelligent animal that thinks that it can think.

Quotations are implemented as lists. Here comes a sample quotation, repeated once to test paragraph indentation of additional paragraphs.

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Table 1 Parameter set used in the model of Bunt [3].

$Q_{s,\max}$	[g/g DM h]	0.18
$K_s$	[g/L]	1.0
$Y_{x/s}$	[g DM/g]	0.5
$Y_{p/s}$	[g/g]	0.854
$Q_{p,\max}$	[g/g DM h]	0.0045
$\mu_{\text{crit}}$	[h <sup>-1</sup> ]	0.01
$k_h$	[h <sup>-1</sup> ]	0.002
$m_s$	[g/g DM h]	0.025

Table 2 The spherical case ( $I_1 = 0$ ,  $I_2 = 0$ ).

Equil. Points	$x$	$y$	$z$	$C$	S
$L_1$	-2.485252241	0.000000000	0.017100631	8.230711648	U
$L_2$	0.000000000	0.000000000	3.068883732	0.000000000	S
$L_3$	0.009869059	0.000000000	4.756386544	-0.000057922	U
$L_4$	0.210589855	0.000000000	-0.007021459	9.440510897	U
$L_5$	0.455926604	0.000000000	-0.212446624	7.586126667	U
$L_6$	0.667031314	0.000000000	0.529879957	3.497660052	U
$L_7$	2.164386674	0.000000000	-0.169308438	6.866562449	U
$L_8$	0.560414471	0.421735658	-0.093667445	9.241525367	U
$L_9$	0.560414471	-0.421735658	-0.093667445	9.241525367	U
$L_{10}$	1.472523232	1.393484549	-0.083801333	6.733436505	U
$L_{11}$	1.472523232	-1.393484549	-0.083801333	6.733436505	U

Mathematical formulas may also be displayed. A displayed formula is one-line long; multiline formulas require special formatting instructions.

$$x' + y^2 = z_i^2$$

Don't start a paragraph with a displayed equation, nor make one a paragraph by itself.

Example of a theorem:

**Conjecture 1** *All conjectures are interesting, but some conjectures are more interesting than others.*

## 4 Tables and Figures

Cross reference should be labelled, e.g., as you can see in Table 2 and also in Table 1.

A major point of difference lies in the value of the specific production rate  $\pi$  for large values of the specific growth rate  $\mu$ . Already in the early pub-

Table 3 Parameter sets used by Bajpai and Reuß.

<i>parameter</i>		<i>Set 1</i>	<i>Set 2</i>
$\mu_x$	[h <sup>-1</sup> ]	0.092	0.11
$K_x$	[g/g DM]	0.15	0.006
$\mu_p$	[g/g DM h]	0.005	0.004
$K_p$	[g/L]	0.0002	0.0001
$K_i$	[g/L]	0.1	0.1
$Y_{x/s}$	[g DM/g]	0.45	0.47
$Y_{p/s}$	[g/g]	0.9	1.2
$k_h$	[h <sup>-1</sup> ]	0.04	0.01
$m_s$	[g/g DM h]	0.014	0.029

lications [15] it appeared that high glucose concentrations in the production phase are well correlated with a low penicillin yield (the ‘glucose effect’). It has been confirmed recently [1,3,5,8] that high glucose concentrations inhibit the synthesis of the enzymes of the penicillin pathway, but not the actual penicillin biosynthesis. In other words, glucose represses (and not inhibits) the penicillin biosynthesis.

These findings do not contradict the results of [13] (on which Bunt [3] based their production kinetics) and of [12] which were obtained for continuous culture fermentations. Because for high values of the specific growth rate  $\mu$  it is most likely (as shall be discussed below) that maintenance metabolism occurs, it can be shown that in steady state continuous culture conditions, and with  $\mu$  described by a Monod kinetics

$$C_s = K_M \frac{\mu/\mu_x}{1 - \mu/\mu_x} \quad (1)$$

Pirt and Rhigelato determined  $\pi$  for  $\mu$  between 0.023 and 0.086 h<sup>-1</sup>. They also reported a value  $\mu_x \approx 0.095$  h<sup>-1</sup>, so that for their experiments  $\mu/\mu_x$  is in the range of 0.24 to 0.9. Substituting  $K_M$  in Eq. (1) by the value  $K_M = 1$  g/L as used by Bunt [3], one finds with the above equation  $0.3 < C_s < 9$  g/L. This agrees well with the work of Bunt [3], who reported that penicillin biosynthesis repression only occurs at glucose concentrations from  $C_s = 10$  g/L on. The conclusion is that the glucose concentrations in the experiments of Pirt and Rhigelato probably were too low for glucose repression to be detected. The experimental data published by Ryu and Hospodka are not detailed sufficiently to permit a similar analysis.

Bajpai and Reuß decided to disregard the differences between time constants for the two regulation mechanisms (glucose repression or inhibition)

because of the relatively very long fermentation times, and therefore proposed a Haldane expression for  $\pi$ .

It is interesting that simulations with the [3] model for the initial conditions given by these authors indicate that, when the remaining substrate is fed at a constant rate, a considerable and unrealistic amount of penicillin is produced when the glucose concentration is still very high [6]. Simulations with the Bajpai and Reuß model correctly predict almost no penicillin production in similar conditions.

The maintenance coefficient used by Bunt [3] ( $m_s = 0.025$  g/g DM h) corresponds well to the value  $m_s = 0.029$  g/g DM h (Set 2 of [2]), to the value  $m_s = 0.024$  g/g DM h reported in [11], and to the value used in [9] ( $m_s = 0.022$  g/g DM h) (1983). However, these values differ from the value in Set 1 of [2] ( $m_s = 0.014$  g/g DM h). It is not clear where this difference originated from. Simulations indicated that the dynamic behaviour of the model is rather sensitive with respect to the value of  $m_s$ .

In the model of Bunt [3], at severe substrate limitation conditions, and thus most probably corresponding to endogenous metabolic behaviour, the biomass consumption due to maintenance and production requirements may exceed the conversion of substrate into biomass and  $\mu$  eventually may become negative. This situation may occur at the end of the growth phase during a fed-batch fermentation. For these conditions  $\pi$  is not defined. A straightforward extension of the  $\pi(\mu)$  kinetics (10) could be  $\pi(\mu \leq 0) = 0$ , but there are some biochemical indications that the penicillin biosynthesis actually does not stop in that case.

Sample of cross-reference to a figure: Figure 1 shows a color image.

## 5 Headings

### 5.1 Subsection

[8, 14] based their model on balancing methods and biochemical knowledge. The original model (1980) contained an equation for the oxygen dynamics which has been omitted in a second paper (1981). This simplified model shall be discussed here.

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Figure 1 Lange ijzeren brug, Dordrecht, The Netherlands.

the oxygen dynamics which has been omitted in a second paper (1981). This simplified model shall be discussed here.

**5.1.1.1 Paragraph.** Carr and Goldstein [8] based their model on balancing methods and biochemical knowledge. The original model (1980) contained an equation for the oxygen dynamics which has been omitted in a second paper (1981). This simplified model shall be discussed here.

## 6 Equations and the Like

Two equations:

$$C_s = K_M \frac{\mu/\mu_x}{1 - \mu/\mu_x} \quad (2)$$

and

$$G = \frac{P_{\text{opt}} - P_{\text{ref}}}{P_{\text{ref}}} 100 (\%) \quad (3)$$

Two equation arrays:

$$\frac{dS}{dt} = -\sigma X + s_F F \quad (4)$$

$$\frac{dX}{dt} = \mu X \quad (5)$$

$$\frac{dP}{dt} = \pi X - k_h P \quad (6)$$

$$\frac{dV}{dt} = F \quad (7)$$

and

$$\mu_{\text{substr}} = \mu_x \frac{C_s}{K_x C_x + C_s} \quad (8)$$

$$\mu = \mu_{\text{substr}} - Y_{x/s}(1 - H(C_s))(m_s + \pi/Y_{p/s}) \quad (9)$$

$$\sigma = \mu_{\text{substr}}/Y_{x/s} + H(C_s)(m_s + \pi/Y_{p/s}) \quad (10)$$

Let us also recall the very first equation 1.

## Appendix

And this is my Appendix.

### Appendix Subsection

Some text.

## References

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## Biography

Here is space for  
a photograph of  
the author.

**Author's name.** A short vitae can be included here.