3.1.5a

Between a symbolic statement and a verbal expression in displayed expressions:

$$b = 0 \#(\text{mod } q) \square \text{ for some } q$$

$$E_n(t) \to e^{-t} \square \text{ as } t \to \infty$$

3.1.5b

Around conjunctions:

$$x(a+b) \square \text{or} \square y(a-b)$$

3.1.6 Two-em quad (⏥)

This spacing should be marked by the copy editor. In text, variable word spacing is used in these cases.

3.1.6a

Between two separate equations or inequalities in the same line of a display.

$$x^2 + y^2 = a, \quad ⏥ \quad x + y = b$$

3.1.6b

Between a symbolic statement and a condition on the statement.

$$x^n - y^n - z^n = A \quad ⏥ \quad (n = 0, 1, \ldots, p).$$

3.2 MATHEMATICAL EQUATIONS IN TEXT

There are various schools of thought on the treatment of equations in text. One is that mathematical expressions may never be broken at the end of a line of text. Another is that only the simplest mathematical expressions are allowed in text. The practice traditionally followed at the AMS was to run simple or short equations into text whenever it was possible to do so without sacrificing clarity. With electronic submissions fewer equations are run in, to preserve the original submission and to reduce the number of corrections to the file. This helps to keep publishing costs down.

Copy editors and authors preparing manuscripts electronically must decide how to treat equations. Should they be displayed or run into text? Factors to be considered when making these decisions include

(a) the importance of an equation,

(b) its relation to other displays,

(c) whether displaying an equation will really improve readability,

(d) whether displaying an equation will really save space, because running one display into text might make it necessary to display subsequent material.

For copy editors, making these decisions requires either a background in mathematics or a great deal of copyediting experience and a strong intuitive feeling for mathematics. When bad breaks do occur at the end

of a line of text, it is the task of the proofreader to find them and to suggest alternatives. In the end, the author has the final say.

To guide copy editors and proofreaders who are not familiar with the mathematics involved, as well as authors who are preparing manuscripts electronically, a set of rules regarding the breaking of equations is given in this section. These rules probably cover 98% or even more of the cases that are encountered in research mathematics. However, no matter how many rules are given, there always seem to be places where common sense, based on experience, is needed.

3.2.1 Definitions

Before rules on the breaking of equations can be given, it is necessary to set up definitions to specify exactly which mathematical symbols are involved in the rules.

To simplify the terminology in the rules given in §3.2.2, a set of definitions appears here so that reference can be made to a whole set of symbols by the use of just one or two words. (The examples given here are not exhaustive.)

Operators :

Verbs : $= \neq < > \leq \geq \prec \succ \ll \gg \nleq \ngeq \subset \supset \in \ni \equiv \not\equiv \sim \not\sim$
$\simeq \cong \rightarrow \leftarrow \Rightarrow \Leftrightarrow \notin$

Conjunctions : $+ \; - \; \times \; \dot{+} \; \mp \; \cup \; \cap \; \vee \; \wedge \; \cdot \; \circ \; \oplus \; \otimes$

Fences : { } [ ] ⟨ ⟩ ( ) | | ‖ ‖

Nouns : italic, Greek, German, and Hebrew letters; numerals

Sigma-class symbols

Collective signs : $\sum \; \prod \; \bigcup \; \bigcap \; \bigwedge \; \bigvee \; \bigoplus \; \bigotimes$

Integral : $\int$

3.2.2 Rules for breaking equations in text

In the examples which illustrate each rule, a / indicates an allowable break demonstrating the rule which precedes it. Additional examples are given in §3.4.

Rule 1. Equations may be broken before or after an operator that is a verb (or after a comma or semicolon) that *does not* occur between fences:

$$a + b/=/x(c - d)$$

Exception: If lines of text are not justified, the break should be after the operator; this alerts the reader to the fact that the mathematical expression continues.

Rule 2. An equation may be broken at any thick space (see §3.1.4):

$$y = 4n - 1/(n = 0, 1, 2)$$

If there is a choice, Rule 2 has precedence over Rule 1. It is better to break at a thick space than before an operator.

Rule 3. After a collective sign, no break is allowed until an operator occurs outside of fences:

$$\sum(a-b)\Big/+\Big/abc$$

Rule 4. After an integral sign ($\int$), no break is allowed until a d occurs; then break after the next punctuation or at a verb.

$$\int a\,dx,\Big/\quad\int a(a+b)(xy-w)\,dx\Big/=$$

Exception : $\int dx+dy$ (NO BREAK ALLOWED)

Rule 5. When a set of fences is followed directly by another set of fences, the equation may be broken between them, provided a times sign or a center dot is inserted:

$$(a+b)\Big/(c+d)$$

(Break at / and insert a times sign or a center dot, as appropriate, before the second set of fences.)

Exceptions: (1) This rule does not apply if the fences are preceded by a sigma-class symbol.

(2) Do not break at the slash (/) in a slashed fraction.

(3) This rule does not apply to logic.

Rule 6. Equations may be broken before or after an operator (or after a comma or semicolon) that occurs between fences if both of the following conditions are present:

(1) if one of the opening fences (that has not closed) is *not* preceded directly by a noun, a fence, or sigma-class symbol and

(2) if the subsequent closing fences are *not* followed directly by a noun or a fence.

It is good policy, however, to avoid breaking equations between fences whenever possible.

NO BREAK ALLOWED:

$$x(a+b+c)\qquad(a+b-c)y\qquad\sum(a+b-c)$$

BREAK ALLOWED, WHEN NECESSARY:

$$(a\log x\Big/-b\sin(x/y))\qquad((\sin a-\cos b)\Big/+\tan c\Big/-(xy\cos b))$$

Rule 7 (for mathematical logic). The rules for breaking mathematical expressions in logic are not always the same as for other branches of mathematics. Generally, expressions should not be broken within fences and should be broken before verbs and conjunctions. In logic & and $\rightarrow$ have more weight than in other mathematics fields. Considering the English equivalent of some symbols might help the compositor or proofreader in making correct breaks.

$\Rightarrow$ and $\rightarrow$ mean *implies* $\Leftrightarrow$ means *if and only if*

& and $\wedge$ mean *and*; $\vee$ means *or*. All three are conjunctions which might take precedence over a verb for breaking purposes.

$\neg$ means *it is not true that*; $\exists$ means *there exists*; $\forall$ means *for all*. Breaks occur before rather than after these symbols.

Do not use either a times sign or a center dot when breaking at a fence; break without any added notation.

$$s = 0 \Big/ \& \Big/ V = 0 \qquad e^* = q(u) \Big/ \rightarrow \Big/ u = M(e^*, t)$$
$$\alpha \in Q \Big/ \wedge \Big/ \beta \in Q \Big/ \wedge \Big/ \alpha \neq \beta \Big/ \rightarrow \Big/ (\exists m) F(\alpha(m), \beta(m))$$

Note that in the mathematical logic examples above, it would be wrong to break at the $=$, $\neq$, or $\in$ signs.

3.3 MATHEMATICS IN DISPLAY

Mathematical equations are set into display rather than into text for several reasons; emphasis and clarity are probably the two main factors. Some authors use display with discretion; some run even extremely long, complicated equations into the text, while others tend to display every equation in the paper. The tendency to overdisplay is probably more predominant than the tendency to underdisplay; for this reason it is possible for the copy editor to shorten (and even improve) papers by running displayed material into text as detailed in §2.5.1. On the other hand, there are occasions when the copy editor needs to suggest the display of complicated expressions that have been run into text, particularly when it would involve a bad break at the end of a text line. Numbered equations must always be displayed.

3.3.1 Numbered displays

When displays are numbered, the most common practice is to place this number in parentheses at the margin. Some publishers place them at the left margin, others at the right. As long as a consistent style is used, the placement is not important. The predominant practice among American publishers of mathematics is to place the equation number at the left margin. When a style file is used, placement of the equation number is taken care of automatically.

3.3.2 Centering displays

Most publishers of research mathematics center displays in a manner similar to that related in this section.

Rules. Center a display so that the distance from the left margin to the first symbol is the same as the distance from the right margin to the last symbol. If centering causes an overlap between the display number and the display, the display may be

(1) centered between the display number and the right-hand margin (or left-hand margin, if display numbers are on the right),

(2) centered on a separate line below the display number, or
(3) broken and displayed on more than one line.
EXAMPLES: In this case the display is centered between margins

$$a^n + b^n + c^n + d^n = A + B, \tag{32.21}$$

but here we have a display where this is not possible unless the display is on a separate line, below the display number

(32.21)
$$(a+b) \,/\, (a_{11} + b_{11}) = (a_{22} + b_{22}) - (a_{21} + b_{21})(a_{11} + b_{11}).$$

3.3.3 Centering several one-line equations

Several equations which occur in succession, with no intervening words, are considered one display. In such cases the first verb symbol occurring in each equation is lined up vertically with the one below; the set of equations is then centered.

The first of the verb symbols occurring in each group of equations are lined up vertically; the set of equations is then centered.

$$\int_0^1 (f+g)\,d\phi \le \int_0^1 \phi\,d\phi = \int_0^1 g\,dg + \int_0^1 f\,df,$$
$$\int_0^1 (F-G)\,d\psi = -\int_0^1 (f-g)\,df = 0,$$
$$F \subset f - g.$$

Note that if there is an intervening word, even if it is just the word "and", the word is placed at the left margin and the display is terminated. The material following the word is then centered and aligned independently.

An author may also decide to center each line separately.

$$\int_0^1 (f+g)\,d\phi \le \int_0^1 \phi\,d\phi = \int_0^1 g\,dg + \int_0^1 f\,df,$$
$$\int_0^1 (F-G)\,d\psi = -\int_0^1 (f-g)\,df = 0,$$
$$F \subset f - g.$$

3.3.4 Rules for breaking equations in display

In general, breaking equations in displays follows the same rules as breaking equations in text. However, breaking displays tends to be more difficult because the more complicated material is usually set into display instead of text.

The rules below are based on the definitions and rules from §3.2.1 and §3.2.2. See §3.4 for examples of the application of the following rules.

Rule A. Rules 1–7 in §3.2.2 on the breaking of equations in text apply also to displays.

Exception: In display, equations may be broken before an operator but *not* after an operator.

Rule B. An equation may be broken at any em or two-em quad.

Rule C. Rules 3, 4, and 6 may be disregarded if the mathematical expressions are so long that there is no alternative. Determining where these expressions should be broken requires mathematical knowledge and/or a great deal of experience with mathematical proof.

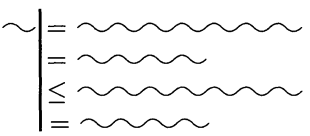
Rule D. The symbols in a matrix or a table should be set in a smaller point size type if they will not fit into the page width. If the matrix is still too long, a direction can be given to the compositor to set it broadside.

3.3.5 Centering multi-line equations

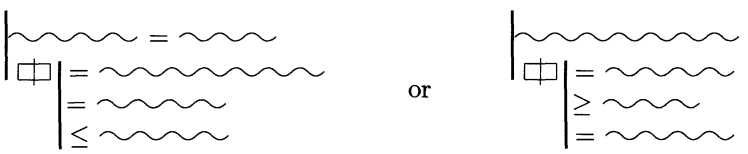
Breaks are made preferably before an operator (verbs and conjunctions).

3.3.5a Break and align on verbs

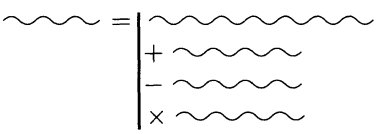
When displayed equations cannot fit within the margins, they should be broken at the verbs (=, ≠, <, > , etc.) and aligned on the verbs.



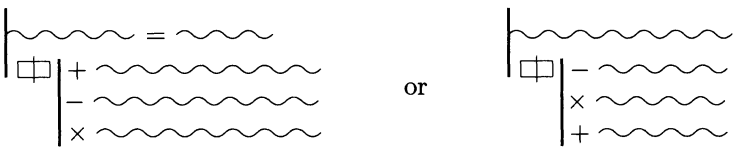
If there is a long expression before the first verb, align succeeding verbs with a two-em quad indent from the left.



3.3.5b Break at conjunctions and align to the right of the first verb

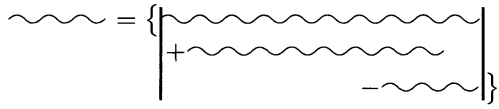


3.3.5c Break at conjunctions and align with two-em quad from left



3.3.5d General rule: always keep expressions visually within fences

If the break occurs within a set of fences, the operator should line up to the right of the opening fence to indicate that this line of display belongs inside the fences.



3.4 TABLE OF RULES FOR BREAKING MATHEMATICS

The rules for breaking expressions in text and in display, illustrated in Table 7, are given in §3.2.2 and §3.3.4.

KEY TO THE TABLE

/ Breaks acceptable in text.

// Breaks acceptable in text and display.

Breaks acceptable in display when other alternatives are not possible.

Breaks not acceptable by any rule. When long and involved expressions occur, it is sometimes impossible to fit them across the page and still abide by all the rules, as seen in this example:

$$\int_U \delta(I)\mu(I) \le \sum_{\mathfrak{D}} \sum_{\mathfrak{D}_{I'}} \Bigg[\int_J \alpha(J')\mu(J') - \alpha(J)\mu(J) - \int_J [\{s(\alpha\eta)(J')\}/\eta(J')]\mu(J') - [\{s(\alpha\eta)(J)\}/\eta(J)]\mu(J) \Bigg] + \Bigg[\sum_{\mathfrak{D}} \sum_{\mathfrak{D}_{I'}} |\alpha(J) - [\{s(\alpha\eta)(J)\}/\eta(J)]|\mu(J) \Bigg] \times \Bigg[\sum_{\mathfrak{D}} \sum_{\mathfrak{D}_{I'}} |\alpha(J) - [\{s(\alpha\eta)(J)\}/\eta(J)]|\eta(J) \Bigg]$$

When none of the rules allow a mathematical expression to fit in a display within the page width, one possible solution is to reduce the expression photographically and paste it onto camera copy or to reduce the expression electronically and pull it in electronically. The result is, of course, to print the elements of the expression in a smaller font. If the entire expression is prepared as a graphic, TEX allows for scaling the graphic at a reduction (and even at an enlargement when desired).

TABLE 7

	RULES THAT APPLY IN TEXT (see §3.2.2)	RULES THAT APPLY IN DISPLAY (see §3.3.4)
$a + b/+ c/\!/= 0$	1	A
$\{a + b/+ c\}/\!/\in G$	6, 1	A
$\{\phi_i \mid i/= 1, /2, /\ldots, n\}$	6	C
$(\{c_n\}, /\{\lambda_{n+1}\})/\!/\subset [a, \infty]$	6, 1	C, A
$(a + b + c)/\!/(d + e + f)$		
(add times sign at break)	5	A
$\{x : \rho(x, H)/< 1/i\}$	6	C
$(a + b/+ c/+ (d + e))$	6	D
$(c + b/+ c(a + b)/+ e(d + e))$	6	C
$\sum_{i=0}^{n} a_i\, f(a + b)/\!/+ [a + d]$	3	A
$\bigcap G \setminus \mathrm{Bd}\, H/\!/ + I$	3	A
$y(a + b)/\!/x(c + d)$		
(add times sign at break)	5	A
$x = 4n/+ 1/\!/ \# (n = 0, /1, /2, /\ldots)$		
(#= 2-em quad in a displayed equation)	1, 2, 6	B
$\int (a + b)xy\, dx/\!/+ O(y)$	4	A
$\int (a + b + c)/(d + e + f)\, dx$		
(add times sign at break)		C
$A(a/\!/+ b/\!/+ c)$		[1]
$\sin(\alpha/\!/+ \beta/\!/+ \gamma)$		[1]
$\int (a/\!/+ b/\!/+ c/\!/+ d)\, dx$		[1]
$[a + b/\!/+ c + d]_0^n$		[1]

[1] By necessity, break only in display. No rule applies.