The
BIOCHEMICAL
JOURNAL

# Announcement: *Research Communications*

- From January 1992 the *Biochemical Journal* will include a new category of paper, the "Research Communication"; simultaneously, the publication of "Rapid Papers" will be discontinued. As with Rapid Papers, Research Communications will be short (maximum four printed pages) articles but, unlike Rapid Papers, where the only criterion for accelerated treatment is length, Research Communications will have to satisfy the additional criterion of "novelty and significance".
- It is intended that Research Communications should be a major feature of the journal; they will appear at the front of each issue (after the review), will be listed separately in the table of contents and will each carry the Research Communication imprint. Communication by fax between editorial office, reviewers and authors will be used extensively to ensure that the target of conveying a decision to authors within 2 weeks of receipt is achieved. Rapid publication after acceptance will be achieved by priority treatment at all stages of the publication process and by not sending proofs to authors.
- The editorial board emphasizes that there is no upper or lower limit to the length of regular articles ("Research Papers") in the *Biochemical Journal*, and in particular that it will continue to welcome the submission of short but non-urgent accounts of completed pieces of work for publication in this category. Such short articles are usually published faster than their longer counterparts.
- The *Biochemical Journal* invites you to submit Research Communications from mid-October 1991 onwards for publication in the early issues of 1992. The appropriate section of the 1992 *Instructions to Authors* appears below.

> Research Communications in the *Biochemical Journal* are short papers bringing particularly novel and significant findings to the attention of the research community. It is intended that a decision on acceptance or rejection will be made within 2 weeks of receipt, and publication of accepted Communications will follow within 2 months. Research Communications will receive full but accelerated reviewing and the criteria of "novelty and significance" will be strictly enforced; Research Communications should not be seen as a path to accelerated publication of sound but non-urgent material. Authors must include in their letter of submission a *brief* statement of why they believe their Communication merits accelerated treatment, and should submit **four** copies of their article. Research Communications should be arranged in the usual style for a *Biochemical Journal* paper (summary, introduction, methods, results and discussion, with sufficient experimental detail to permit repetition of the work) and should not be longer than four printed pages of the journal [about 4000 words (24000 characters) of uninterrupted text, including references, but this number should be decreased to allow for the space taken up by figures and tables]. Research Communications may be submitted by fax (unless they contain half-tone figures); in any case, provision of a fax number in the covering letter will enable the decision and any queries to be communicated to authors as quickly as possible.


- **The *Biochemical Journal* is published for the Biochemical Society by Portland Press Ltd.**
- **Submit articles to *Biochemical Journal*, 59 Portland Place, London W1N 3AJ, U.K.**
- **Telephone (+44) 071-637 5873; facsimile 071-323 1136**

PORTLAND
PRESS

# The BIOCHEMICAL JOURNAL



Volume 281, part 1 1 January 1992

## Editorial Board



- The Biochemical Journal is published and distributed by Portland Press Ltd. on behalf of the Biochemical Society, and appears twice monthly.
- Editorial and Publishing Offices: The Biochemical Journal, 59 Portland Place, London W1N 3AJ, U.K.
- Subscriptions Department: Portland Press Ltd., P.O. Box 32, Commerce Way, Colchester CO2 8HP, U.K.

- Second-class postage paid at Rahway, NJ, U.S.A.
- U.S. Postmaster: send address changes to The Biochemical Journal, c/o Mercury Airfreight International Ltd, 2323 Randolph Avenue, Avenel, NJ 07001, U.S.A. (US mailing agent).

## INSTRUCTIONS TO AUTHORS

### General policy

The *Biochemical Journal* publishes papers in English in all fields of biochemistry, provided that they make a sufficient contribution to biochemical knowledge. Papers may include new results obtained experimentally, descriptions of new experimental methods of biochemical importance, or new interpretations of existing results. Theoretical contributions will be considered equally with papers dealing with experimental work. All work presented should have as its aim the development of biochemical concepts rather than the mere recording of facts. Preliminary, confirmatory or inconclusive work will not be published.

Submission of a paper implies that it has been approved by all the named authors, that all persons entitled to authorship have been so named, that it reports unpublished work that is not under consideration elsewhere, and that if the paper is accepted for publication the authors will transfer to the Biochemical Society the copyright in the paper, which will then not be published elsewhere in the same form, in any language, without the consent of the Society. Authors will be required to sign an undertaking to these effects.

The *Biochemical Journal* will not publish material that has been wholly or largely published elsewhere, even as a preliminary communication or in unrefereed symposium proceedings; equally, fragmentation of research into the "least publishable unit" is discouraged. In order that the reviewers can consider these problems, all submitted papers must be accompanied by duplicate copies of the author's relevant published work and of all related papers in press or under editorial consideration in this or other journals.

Authors may suggest potential reviewers for their papers, but the journal is under no obligation to follow such suggestions. Authors may also specify the names of those they wish to be excluded from the review process, and such wishes are usually respected unless, in the opinion of the journal, such a request unreasonably excludes all the expertise available to it in that scientific area.

The paragraphs below are a summarized version of the journal's complete Instructions to Authors [*Biochem. J.* (1992) **281**, 1–19], of which copies are available free of charge from the editorial office.

The following types of paper are included in the journal.

**Research Papers** are the normal form of publication, and may be of any length that is justified by their content. However, because of pressure for space in the journal, no paper, whatever its scientific merits, will be accepted if it exceeds the minimum length required for precision in describing the experiments and clarity in interpreting them. As a guide, most Research Papers published in the *Biochemical Journal* are of between six and eight printed pages. A concise well-written paper tends to be published more rapidly.

**Research Communications** are short (maximum four printed pages) papers bringing particularly novel and significant findings to the attention of the research community. It is intended that a decision on acceptance or rejection will be made within 2 weeks of receipt, and publication of accepted Communications will follow within 2 months. Research Communications receive full but accelerated reviewing and the criteria of "novelty and significance" are strictly enforced; Communications are not a path to accelerated publication of sound but non-urgent material. Authors must include in their letter of submission a *brief* statement of why they believe their Communication merits accelerated treatment, and should submit *four copies* of their article.

**BJ Letters** are short (two printed pages or less) items of scientific correspondence intended to provide an opportunity to discuss, criticize or expand particular points made in published work, or to present a new hypothesis. They should not contain extensive new data (which would best be placed in a regular paper) and are not a vehicle for publication of preliminary results. If a letter is polemical in nature, a reply may be solicited from other interested parties.

**Reviews** will usually be solicited, although unsolicited reviews will be considered for publication. Prospective writers of reviews should first consult the reviews editor, via the editorial office, and should enclose a short (one typed page) summary of the area they propose to cover.

### Procedure for submission

Before preparing papers for the journal, authors should consult a current issue to make themselves familiar with the general format, such as the use of cross-headings, layout of tables and figures and citation of references.Typescripts should be double-spaced throughout (particularly references and table and figure legends) on numbered sheets of uniform size (preferably ISO A4) with wide margins. Output from low-quality dot matrix printers is not acceptable. A full page of text in the *Biochemical Journal* contains approximately 1200 words; when calculating the printed length of papers, allowance must be made for the space occupied by tables and figures and the number of text words reduced accordingly.

Either the Harvard system or the numerical system of references may be used. A reference to "unpublished work" should be accompanied by the names of all persons concerned; a reference to a "personal communication" must be supported by written permission for the quotation from the person or persons concerned; both of these types of citation are permitted in the text only, not in the list of references.

Three copies of the typescript (four copies for Research Communications), with a brief covering letter to which should be attached an additional copy of the synopsis, should be sent to:

**The Managing Editor**
**The Biochemical Journal**
**59 Portland Place**
**London W1N 3AJ**
**U.K.**

(telephone 071-637 5873; fax 071-323 1136; from overseas the international code for the U.K. is 44 and the leading 0 should be omitted).

The typescript should indicate the name, address, telephone number and fax number of the person to whom correspondence should be addressed. The top copy of the typescript should be marked as such and should have attached to it the original figures; for the other copies of the typescript, glossy prints (*not* photocopies) of the half-tone figures should be provided, but photocopies of line drawings will suffice. A short (page-heading) title of not more than 75 characters should be provided, and authors should indicate the preferred section in the table of contents for their paper:

*Proteins*
*Enzymes*
*Carbohydrates and lipids*
*Gene structure and expression*
*Regulation of metabolism*
*Membranes and bioenergetics*
*Receptors and signal transduction*
*Cell biology and development*

### Submission by fax

Research Communications and BJ Letters that do not contain half-tone figures may be submitted by fax to the number above. Only one copy of the typescript need be transmitted. Acknowledgment of receipt and the review decision will be returned by fax to the author. The current Instructions to Authors contains full details of this procedure.

### Submission on diskette

Authors may submit a diskette containing the final version of the text; this should be in addition to, not as a replacement for, the required number of copies. If the paper is accepted, every effort will be made to use the diskette during typesetting, but this cannot be guaranteed. Authors wishing to submit their text in this way should consult the editorial office for advice before preparation of their paper.

## OTHER INFORMATION

The *Biochemical Journal* is published and distributed by Portland Press Ltd on behalf of the Biochemical Society. It is published twice monthly; in 1992 volumes 281–288 (three parts each) will appear. The subscription also includes the annual compendium of *Biochemical Journal Reviews* and an author and keyword index.

### Subscription rates

Institutional subscription rates for 1992 are shown below. Subscribers to the *Biochemical Journal* can subscribe additionally to *Biochemical Society Transactions* on a joint subscription, saving $25.00 (North America) or £15.00 (rest of the world). Terms are cash with order (£ sterling for subscribers other than in North America, or US$ equivalent at current rate of exchange), or against proforma invoice. Orders should be sent to the address below, or through your usual agent.

| | North America | Rest of the world |
|---|---|---|
| One year (8 volumes) | US$ 1460 | £775 |
| Single issues | US$ 65 | £33 |

The subscription rates for North America and Japan include elements for airfreight and Accelerated Surface Post respectively. Subscribers may opt for air-mail delivery at additional cost; details are available on application.

### Microfiche and back issues

Volumes 102–280 of the *Biochemical Journal* are available on microfiche. Back issues are also available. Further details may be obtained from the address below.

### Subscription department

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Colchester CO2 8HP, Essex, U.K.
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# The BIOCHEMICAL JOURNAL



Volume 281 1992

## Editorial Board

**Portland Press Ltd**
**59 Portland Place**
**London W1N 3AJ, U.K.**

**ISSN 0264-6021**

*Printed in Great Britain by the University Press, Cambridge*

Biochem. J. (1992) 281, 1–19 (Printed in Great Britain)



# POLICY OF THE JOURNAL AND INSTRUCTIONS TO AUTHORS FOR 1992

## Policy and organization of the journal

### General policy

It is the policy of the *Biochemical Journal* to publish papers in English in all fields of biochemistry, provided that they make a sufficient contribution to biochemical knowledge. Papers may include new results obtained experimentally, descriptions of new experimental methods of biochemical importance, or new interpretations of existing results. Theoretical contributions will be considered equally with papers dealing with experimental work. All work presented should have as its aim the development of biochemical concepts rather than the mere recording of facts. Preliminary or inconclusive experiments should not generally be described. The *Biochemical Journal* will not publish material that has been wholly or largely published elsewhere, even as a preliminary communication or in unrefereed symposium proceedings; equally, fragmentation of research into the "least publishable unit" is discouraged.

Submission of a paper to the *Biochemical Journal* implies that it has been approved by all the named authors, that all persons entitled to authorship have been so named, that it reports unpublished work that is not under consideration for publication elsewhere, and that if the paper is accepted for publication the authors will transfer to the Biochemical Society the copyright of the paper, which will then not be published elsewhere in the same form, in any language, without the consent of the Society. Authors will be required to sign an undertaking to these effects.

The following items are included in the journal.

**1. Research Papers** are the normal form of publication, and may be of any length that is justified by their content. Authors should, however, note that no paper, whatever its scientific merits, will be accepted if it exceeds the minimum length required for precision in describing the experiments and clarity in interpreting them. As a guide, most papers are of between six and eight printed pages. A concise well-written paper tends to be published more quickly.

**2. Research Communications** are short (four printed pages or less) articles bringing particularly novel and significant findings to the attention of the research community. They receive full but accelerated reviewing (the intention is to provide authors with a decision within 2 weeks of submission) and accelerated publication (about 2 months after acceptance).

**3. BJ Letters** are short items of scientific correspondence intended to give authors the opportunity to discuss, criticize or expand previously published work, or to present a new hypothesis. They should not be comments on general aspects of science, and are not a vehicle for publication of preliminary or inconclusive results. If a letter is polemical in nature, a reply for simultaneous publication may be sought from other interested parties. Letters are restricted to two printed pages.

**4. Reviews** will usually be solicited, although unsolicited reviews will be considered for publication. Prospective writers of reviews should first consult the Reviews Editor, via the editorial office, and should enclose a short (one typed page) summary of the area they propose to cover.

The interpretation of this policy is in the hands of the Editorial Board, who judge whether each paper submitted is acceptable in terms of science and presentation.

### Editorial office

The editorial office, which is part of Portland Press, the publishing division of the Biochemical Society, is administered by the Managing Editor. He is concerned with all aspects of the processing, subediting and printing of the *Biochemical Journal*. The Managing Editor is responsible to the Chairman of the Editorial Board, who, on behalf of the Editorial Board, takes responsibility for the journal's content. All correspondence concerning publication of the *Biochemical Journal* should be directed to the Managing Editor at the journal's London address given on p. 4.

### The Editorial Board and the Editorial Advisory Panel

Members of the Editorial Board, which is international, are appointed by the Executive Committee of the Biochemical Society on the recommendation of the Editorial Board. The composition of the Board is such that there is a wide range of expert opinion covering most areas of biochemical research.

The Editors are supported by an international panel of some 400 Editorial Advisers. These are independent reviewers, who are expert each in their own specific field of biochemistry, and who review up to ten papers a year for the journal. The close association of the Advisers with the journal means that a high standard of reviewing can be maintained.

Editors normally serve for a period of 5 years, although this may be extended for a further 2 years in some cases. The composition of the Advisory Panel is reviewed each year. The names of the members of the Editorial Board are published in each issue of the journal; those of the members of the Advisory Panel also appear from time to time.

Authors may suggest potential reviewers for their paper in the letter of submission, but the journal will usually regard such suggestions as a guide only and is under no obligation to follow them. Authors may also specify the names of those they wish to be excluded from the review process for a particular paper, and in such cases their wishes are usually respected, unless, of course, in the opinion of the journal such a request unreasonably excludes all the expertise available to it in that scientific area.

### Handling of papers

Copies of submitted papers are sent simultaneously to a selected Adviser (or, rarely, to another independent reviewer) and to a relevant Editor. The Adviser (or other reviewer) assesses the paper and sends the report to the Editor by a date stipulated by the editorial office. The Editor will, in the meantime, have reached an independent judgement and, on receipt of the report, compiles a combined editorial report based on both opinions. In some cases, Editors will seek further advice from other scientists, and the report then reflects the views of all consulted. If the Editor and Adviser disagree, even after direct discussion, a second Editor is asked for an opinion and, if need be, a further Adviser. This will also be done not infrequently when review of a paper demands expertise in more than one field of biochemistry. All papers are therefore seen by at least two independent scientists, and often by more. The time taken for review is monitored by the editorial office, so that the policy of the journal to give authors rapid decisions is sustained.

When a paper is judged to have scientific merit and thus to be basically acceptable, the editorial office sends an appropriate letter to the authors together with an editorial report containing comments for the authors' consideration. After revision by the author the paper is checked by an Editor before being finally prepared for press by the subeditors. After typesetting, proofs are supplied to authors (except for Research Communications and BJ Letters) for correction of printer's errors only. On publication, 50 free reprints are supplied per paper; more may be purchased at modest cost.

If a paper is to be declined, the reports and correspondence are seen by the Chairman or one of the Deputy Chairmen, who then writes an explanatory letter to the authors. Papers may be declined for several reasons. They may, in the opinion of the reviewers, be unsatisfactory scientifically in that the methodology is open to criticism or that the conclusions are not sufficiently supported by the evidence presented. They may contain material that is, in principle, of interest but which is not clearly expounded; many papers suffer from being overlong with the result that the salient points are not as clear to the reader(s) as to the author(s). They may be sound but only of peripheral biochemical interest and thus of more relevance to another discipline. Finally, and often most contentiously, they may represent an insufficient advance in knowledge. It cannot be overemphasized that, because of pressure for space in the journal, scientific soundness alone is not sufficient reason for publication of a paper; it must represent a definite and significant contribution to the field of study. Thus, in general, preliminary or confirmatory papers, or those reporting the existence of well-known biochemical processes in sources not previously studied, will not be accepted.

The Chairman's, or Deputy Chairman's, letter will set out the reasons why a paper is declined and will indicate whether this decision is a final one or whether suitable revision might improve the paper sufficiently for it to be reconsidered. In this latter instance, encouragement for resubmission does not imply that a revised version will necessarily be accepted. In all cases the decision of the Chairman of the Editorial Board will be final.

If a paper that is returned to the authors for amendment, for whatever reason, is not resubmitted within 3 months (1 month for Research Communications) it will be treated as a new paper and the date of receipt will be altered to the date of resubmission.

It is accepted that the reviewers may from time to time come to decisions that are not easily accepted by authors. This may be because of a conflict of opinion or, for example, and as frequently happens, because the authors' point is felt by the reviewers to be obscured by the presentation. The journal is always willing to hear from authors and to consider their views sympathetically. In rare cases, and if the reviewers and the Chairman agree, the usual anonymity of the reviewers may be set aside to allow discussion between all parties concerned.

# Instructions to authors

### General requirements for submission of papers

The main way in which authors can contribute to shortening the time between receipt and publication of a paper is to follow the requirements and suggestions in these Instructions to Authors, and to write in a concise style, although sufficient information must always be included to permit repetition of the experimental work and to support the conclusions that are drawn. Papers containing prolix or repetitive text or unnecessary figures or tables will always be returned for revision, with consequent delay in publication. Fragmentation of research into the 'least publishable unit' should be avoided, and authors considering the submission of a series of papers on the same topic, which usually involves some degree of repetition, should consider whether journal space could be saved without loss of clarity of presentation by appropriate combination of two or more papers.

The *Biochemical Journal* publishes papers in all fields of biochemistry; therefore, it is important that papers on specialized subjects should be written in such a way that their approach and conclusions are intelligible to the informed, but non-specialist, reader of the journal.

### Procedure for submission

Three copies (four copies for Research Communications) of the typescript should be submitted, together with a brief covering letter. The first page of the typescript should bear the name, address, telephone number and, if possible, facsimile (telecopier) number of the person to whom correspondence (including proofs) should be sent. An additional copy of the synopsis should be enclosed to facilitate selection of reviewers. The top copy, clearly marked as such and typed on one side of the paper only, should be accompanied by the original artwork (see pp. 6–7 for advice on the preparation of figures). Photocopies of line drawings are acceptable for the other copies, which may be typed on both sides of the paper, but glossy prints (**not** photocopies) of all the half-tone figures must be provided. To allow the reviewers to assess possible overlap with previous work, all papers must be accompanied by duplicate copies of the author's relevant published work and of all related papers that are in press or under editorial consideration in this or other journals. Failure to do so may lead to delay in the evaluation of the paper.

Authors should state under which section in the contents list their papers should appear:

*Proteins*
*Enzymes*
*Carbohydrates and lipids*
*Gene structure and expression*
*Regulation of metabolism*
*Membranes and bioenergetics*
*Receptors and signal transduction*
*Cell biology and development*

### Research Communications

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merits accelerated treatment, and should submit **four** copies of their article. Research Communications should be arranged in the usual style for a *Biochemical Journal* paper (synopsis, introduction, methods, results and discussion, with sufficient experimental detail to permit repetition of the work) and should not be longer than four printed pages of the journal [about 4000 words (24000 characters) of uninterrupted text, including references, but this number should be decreased to allow for the space taken up by figures and tables]. Research Communications may be submitted by fax (unless they contain half-tone figures); in any case, provision of a fax number in the covering letter will enable the decision and any queries to be communicated to authors as quickly as possible.

**Submissions by facsimile**

To accelerate handling of Communications and Letters, particularly from outside the U.K., they may be submitted by facsimile (telecopier) and, for such papers only, acknowledgement of receipt and the review decision will be transmitted to authors by facsimile. The criteria for submission in this way are: (i) that the paper meets the length requirement for a Communication or Letter, (ii) that the whole submission (covering letter, double-spaced text, tables and figures and their legends, and any supporting material) should not exceed 20 pages of A4 paper, and (iii) that, because of the technical limitations of facsimile transmission and the requirement (see above) that original prints of half-tone illustrations should be provided for the reviewers, the paper does not contain such half-tones. Original artwork of papers submitted in this way should be retained by authors until they receive acknowledgement of receipt; it should then be sent to the editorial office by post or courier, quoting the manuscript reference number, together with a further copy of the typescript (required for the printer if the paper is accepted). If a facsimile-submitted paper is rejected, a copy of the decision letter and the artwork will be returned to the authors by post. Authors submitting by facsimile need transmit only one copy of their paper; they should also be sure to include a facsimile response number in their covering letter.

**Format of papers**

Before preparing papers, authors should consult a current issue of the journal to make themselves familiar with the general format, such as the use of cross-headings, lay-out of tables and citation of references. Typescripts must be in double-spaced typing throughout (including the references and legends of tables and figures) on sheets of uniform size (preferably ISO A4) with wide margins. Pages should be numbered. Typescripts produced on low-quality dot-matrix printers may not be of an acceptable standard, particularly with respect to the superscripts and subscripts often found in scientific work.

The full title should be concise but informative enough for use in coding for information storage and retrieval. Papers should also be headed by the authors' names (preferably with one forename in full for each author, other forenames being given as initials) and by the name and address (including postal code) of the establishment(s) where the work was done. If there is more than one establishment involved in the work, authors' names should be linked to the appropriate establishment by the use of symbols *, †, ‡, §, ‖ and ¶, in that order. A short (page heading) title of up to 75 characters should also be given.

Separate papers in a series should not be numbered, but subtitles may be used if they are particularly necessary.

The synopsis, which can be in numbered sections, should be of less than 250 words (60 words for Communications) and normally only 3–4% of the length of the paper. It should be as informative as possible for abstracting journals or 'fringe' readers but should not contain inessential details or material not described in the body of the paper. No synopsis is required for reviews or BJ Letters.

The main body of the paper may be divided into (*a*) the Introduction; (*b*) Experimental, including materials and methods; (*c*) Results; (*d*) Discussion; (*e*) acknowledgements, including details of financial support; (*f*) References. It is often an advantage to combine (*b*) and (*c*) (e.g. in papers describing techniques) or (*c*) and (*d*) with gains of conciseness and clarity. In chemical papers, the Experimental section may be placed after the Discussion. The Discussion section should not recapitulate the Results, but only discuss their implications.

Authors may find it helpful to know that a full page of text in the *Biochemical Journal* contains approximately 1200 words. When calculating the printed length of papers, allowance must be made for the space taken up by insertions such as figures, tables and schemes, and this is best assessed by inspection of similar insertions in a recent copy of the journal. A quick method of estimating the printed length of typescripts is to add the number of pages (including references, but not figure or table legends) to the number of figures and tables and divide the total by 4. This assumes double-spaced typing on A4 paper with normal margins.

**Submission of articles on computer diskettes**

Authors who have prepared their typescripts on word processors may include a diskette containing the final version of the text with their submission; this should be in addition to, not as a replacement for, the required number of copies. Every effort will be made to use the diskette during typesetting, but this cannot be guaranteed. Authors wishing to submit their text in this way should contact the editorial office for advice before preparation of the article.

# Submission checklist

- ☐ **Covering letter**
- ☐ **Master copy of typescript, double spaced, containing:**
  - complete text in appropriate style, pages numbered
  - names (including forenames) and addresses of authors
  - name, address, telephone and fax numbers of corresponding author
  - synopsis
  - short (page heading) title
  - abbreviations footnote
  - acknowledgements
  - checked references
  - tables, with titles and legends
  - figure legends, with titles
  - original artwork
  - copies of artwork, with lettering indicated
- ☐ **Two (three for Research Communications) further complete copies of the typescript, with glossy prints of all half-tone figures**
- ☐ **Additional copy of the synopsis**
- ☐ **Proposed section for Table of Contents**
- ☐ **Duplicate copies of relevant published work and all related papers in press or under editorial consideration**
- ☐ **Evidence of approval of personal communications**
- ☐ **Evidence of submission of nucleic acid sequences to an appropriate data bank**

**Addresses for correspondence**

• All **submissions, correspondence about papers, proofs and requests for permission to reproduce material** should be addressed to:

The Managing Editor
The Biochemical Journal
59 Portland Place
London W1N 3AJ
U.K.
telephone (U.K.) 071-637 5873
(from overseas) +4471 637 5873
facsimile (U.K.) 071-323 1136
(from overseas) +4471 323 1136

• All correspondence about **reprints** should be addressed to:
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(from overseas) +4471 323 1136

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* Note that this number will change on 17 August 1992 to 0206-796351 (+44 206 796351 from overseas).

# Notes on the preparation of papers



For nomenclature please refer to the separate section on pp. 10–14, or, for specialized problems, the relevant documents listed there.

The *Biochemical Journal* uses as a standard for spelling the Concise Oxford Dictionary of Current English (Clarendon Press, Oxford). For the technique of writing, authors may find it helpful also to consult The Complete Plain Words, by Sir Ernest Gowers (H.M.S.O. and Penguin Books, London). Authors are encouraged to employ their own style, although papers must be concise and should conform to normal English usage.

The following items in the present section are listed in alphabetical order.

**Acknowledgements**

These should be placed between the end of the text and the reference section, and must be as short as possible.

**Animals**

The full binominal Latin names should be included for all experimental animals other than common laboratory animals. The strain, and if possible the source, of laboratory animals should be stated. The source, and if possible the composition, of the diet of laboratory animals should be specified; this is particularly important in papers reporting the effects of dietary manipulation.

**Centrifuging**

When conditions for centrifuging are critical, sufficient information should be given for the procedure to be repeated. The quantitative composition of the suspension medium should be stated. The centrifuge rotor should be unambiguously identified and the temperature of operation stated.

The time of operation of the rotor at sustained plateau speed (ignoring initial rotor acceleration and deceleration periods) should be stated. The centrifugal field should be stated in multiples of $g$ (as defined on p. 16), based on the average radius of rotation of the liquid. For example: 'The rotor was operated for 15 min at 2 °C and 10000 $g$ ($r_{av.}$ 8 cm).'.

Alternatively, when it is necessary to take into account periods of acceleration and deceleration of the rotor, the rotor speed ($\omega$ in rad/s) and time of operation should be integrated and the total integrated field-time stated (as multiples of $g$) for the average radius of rotation ($r_{av.}$) of the column of liquid in the rotor. For example: 'The rotor was operated at 5 °C. The integrated field-time was 250000 $g \cdot$min at $r_{av.}$ 6.5 cm' [i.e. $(r_{av.}/g) \int_0^t \omega^2 \cdot dt = 250000$ (at $r_{av.}$ 6.5 cm)].

**Density-gradient centrifugation.** The make of centrifuge and rotor used, the temperature of the run and the composition of the gradients should be stated. Results should preferably be plotted against distance from rotor centre rather than against fraction numbers; it is then unnecessary to indicate top and bottom of the gradient. If fraction numbers are used, the top and bottom of the gradient should be indicated.

**Ultracentrifuge data.** Sedimentation coefficient (*not* constant), $s$; sedimentation coefficient corrected at 20 °C in water, $s_{20,w}$; sedimentation coefficient at zero concentration, $s^0$, $s^0_{20,w}$; Svedberg unit ($10^{-13}$ s), S; partial specific volume, $\bar{v}$; diffusion coefficient, $D$, $D^0$, $D_{20,w}$ etc. as for sedimentation coefficient. The temperature at which the sedimentation and diffusion measurements are made should be stated.

## Chromatography

Photographs or drawings of paper or thin-layer chromatograms are not published unless they convey information, such as a demonstration of homogeneity, that is not readily established in the text.

The rate of movement of a substance relative to the solvent front in paper or thin-layer chromatography is best expressed as its $R_F$ value, or, if relative to a reference compound, by its $R_{compound}$ value. Solvents should be described in the form butan-1-ol/acetic acid/water (4:4:1, by vol.) or butan-1-ol/acetic acid (4:1, v/v).

Elution diagrams for chromatographic columns should be shown with the effluent volume increasing from left to right. Units of concentration and volume must be shown clearly. Column (i.e. bed) dimensions should always be quoted, and where possible column void volumes ($V_0$) should be given. Elution zone maxima may be characterized by elution volumes ($V_e$) or preferably by partition coefficients ($\alpha$ or $K_D$). The course of any eluent gradients used should be indicated clearly. Column calibration curves (e.g. plots of molecular mass against $V_e$ or $K_D$) will not be published.

T.l.c., g.l.c., h.p.l.c. and f.p.l.c. are all acceptable abbreviations and need not be defined.

## Computer programs

If the use of a computer program forms a significant and essential part of the work described in a paper, the program must be adequately documented, if not in the paper itself, then by reference to a previously published original source, or by deposition of the program listing with a suitable depository (it should be noted, however, that the Editorial Board cannot accept the responsibility of checking the accuracy of such deposited programs).

## Deposition of data

Information (computer programs, evidence for amino acid sequences, spectra, etc.) supplementing papers in the *Biochemical Journal* may be deposited free of charge with the British Library Document Supply Centre (DSC), Boston Spa, Wetherby, West Yorkshire LS23 7BQ, U.K., where it will be stored in its original form. The supplementary material must in the first instance be sent to the journal with the parent paper, and **not** direct to the DSC. It may be subject to editing in the normal manner before being accepted for deposition and the authors will then be responsible for preparing camera-ready copy according to the following specifications.

(*a*) Maximum page size for text or tables in typescript or computer printout: 33 cm high × 24 cm wide, including margins. Optimum page size: A4.

(*b*) Tabular matter should be headed descriptively on the first page, with column headings recurring on each page.

(*c*) Pages should be clearly numbered to ensure the correct sequence is retained.

(*d*) It is suggested that some prefatory text should be included, such as the author's abstract from the parent paper.

(*e*) Characters, whether typescript, manuscript or computer printout, should be black on white paper, with good contrast. Coloured originals, especially NCR blue copies, are not suitable for reproduction, nor are under-toned (i.e. pale grey) xerographic copies. Colour-striped computer stationery should be avoided.

(*f*) Half-tones and plates cannot be reproduced adequately by the processes employed, and such material should not be deposited for its own sake, but only if it forms an integral part of other supplementary material.

(*g*) Microfiche and COMfiche can be accepted only in exceptional circumstances.

(*h*) Computer printout should not be greatly photoreduced: no more than 35% linear reduction is acceptable. There is little point in depositing for posterity barely legible material which cannot be reproduced by the processes available (i.e. xerography and microphotography). Structure factor tables prepared from computer printout must be presented as indicated above, and not in the form of continuous printout.

The editorial office will be responsible for depositing the material with the DSC at this stage.

Copies of supplementary publications may be obtained from the DSC. Requesters must quote the relevant supplementary publication number (e.g. SUP 12345) given in the paper in question. Registered DSC customers should use their normal request procedures. To others, supplementary publications will be available on a pro forma invoice basis. For details contact Customer Services (telephone 0937-546060/facsimile 0937-546333) at the address above.

A memorandum on the preparation of material for data deposition is available from the *Biochemical Journal* editorial office on request.

## Electrophoresis

Photographs of electrophoretic separations in gels such as polyacrylamide may be published if they convey essential information; line drawings, or densitometric records, may be more informative.

Electrophoretic mobilities ($m$) and the composition of the electrophoretic medium, pH and temperature should be quoted. The operative voltage should be specified where possible.

The symbol pI should be used for isoelectric point. PAGE is an acceptable abbreviation and need not be defined.

## Enzymes

**Enzyme nomenclature.** The recommendations of the latest edition of Enzyme Nomenclature [(1984) Academic Press, London and New York; ISBN 0 12 227163 7 (paperback) or ISBN 0 12 227162 9 (hardback)] and its supplements [Eur. J. Biochem. (1986) **157**, 1–26; (1989) **179**, 489–533] will be followed as far as possible. This includes the quoting of EC numbers.

**Enzyme units.** Units of the amount of enzyme should be

defined in each paper, and this may be done in terms of the rate of reaction catalysed under conditions specified. The SI unit for the rate is 1 mol of substrate transformed/s (or, if necessary, 1 mol of measured product formed/s), and this gives the unit of the amount of enzyme that has been given the name of katal (symbol: kat) [see Eur. J. Biochem. (1979) **97**, 319–320, corrected in Eur. J. Biochem. **104**, 1 (1980)]. Units of the amount of enzyme may, however, be expressed in terms of the amount that can catalyse other rates, e.g. 1 $\mu$mol of substrate transformed/min.

**Standard protein solutions.** When standard proteins such as BSA are used as a basis for the determination of other protein concentrations, the type of protein, its source of supply and the moisture content (if appropriate) should be given.

**Kinetic constants.** Velocity constants for the forward and the backward reactions in the $n$th step of an enzymic reaction should be represented by $k_{+n}$ and $k_{-n}$ respectively. The Michaelis constant is defined as $K_m = [S]$ when $v = V/2$, where $v$ is the velocity of appearance of product or disappearance of substrate at a given substrate concentration [S] and $V$ (or $V_{max.}$) is the velocity when the enzyme is saturated with the substrate. When reactions with two substrates A and B are being considered $K_m^A = [A]$ when $v = V/2$ and [B] has been extrapolated to infinity; a value for [A] when $v = V/2$ at a finite concentration (which must be specified) of B should be referred to as apparent $K_m$ for A. $K_s$ is the equilibrium constant of the dissociation of the substrate–enzyme complex. $EC_{50}$ (concentration giving half-maximal response) and $IC_{50}$ (concentration giving half-maximal inhibition) need not be defined.

### Ethics of animal experimentation

Experiments with animals should be performed in accordance with the legal requirements of the relevant local or national authority. Procedures should be such that experimental animals do not suffer unnecessarily. The text of papers should include experimental details of the procedures and of anaesthetics used. The Editorial Board will not accept papers where the ethical aspects are, in the Board's opinion, open to doubt.

Information and advice about experiments involving animals are to be found in Guidelines on the Use of Living Animals in Scientific Investigations (1984), ISBN 0 9500213 1 8, obtainable from The Biological Council, c/o Institute of Biology, 20 Queensberry Place, London SW1 2DZ, U.K., price £1.50, post free.

### Ethics of human experimentation

The Editorial Board agrees with the recommendations in the Report of the Medical Research Council for 1962–63 [Br. Med. J. (1964) **ii**, 178–180]. Authors should ensure that their work complies with these recommendations. A paper describing any experimental work with humans should include a statement that the Ethical Committee of the Institution in which the work was performed has approved it, and should state that the subjects have given informed consent to the work.

### Ethics of scientific publication

Authors may like to refer to the 'Ethical Guidelines to Publication of Chemical Research' formulated by the American Chemical Society [see Biochemistry (1986) **25**, 9A–10A].

### Experimental hazards

Authors should draw attention to any particular chemical or biological hazards that may be involved in carrying out the experiments described. It may be appropriate to describe relevant safety precautions taken for any hazard, or to include a statement that an accepted code of practice has been followed. In the latter case a reference to the relevant standards should be given.

### Footnotes

These should be avoided, except in tables and in footnotes to the title page concerning abbreviations, the address for reprint requests, an author's current address or a sequence database accession number (in that order). Reference is made by the symbols * † ‡ § ‖ ¶, in that order.

### 'Homology'

The term 'homologous' has a precise meaning in biology of 'having a common evolutionary origin', but it has recently often been used in work on protein and nucleic acid sequences to mean simply 'similar'. A group of experts has urged that the interests of clarity are best served by restricting use to the more precise definition [Reeck, G. R. *et al.* (1987) Cell **40**, 667; Lewin, R. (1987) Science **237**, 1570]. The Biochemical Journal agrees with these arguments and aims to preserve the distinction between 'homologous' and 'similar' in its pages.

### Illustrations

Each illustration should be on a separate sheet and packed flat; each should bear the author's name, the title (abbreviated if necessary) of the paper and the figure number on the back. Its approximate position should be indicated in the margin of the typescript. Illustrations constitute an expensive item of publication; their number should be kept to a minimum.

**Titles and legends.** Each illustration should be supplied with an informative title and an explanatory legend, starting on a new line and typed double-spaced. The title and legend should make the general meaning comprehensible without reference to the text. Conditions specific to a particular experiment should be stated. Reference to the text for general experimental details is permissible provided there is no ambiguity. All figure legends should be grouped in a section at the end of the text.

**Line diagrams.** Artwork should be supplied in a form (apart from lettering, which can be in ink or pencil) that can be reproduced directly by the printer. It is therefore essential for authors to adhere to the following instructions with regard to the preparation of line drawings for figures; otherwise their illustrations will have to be returned to them, with consequent delay.

Diagrams should be in black ink on white paper or card; if graph paper is used it must have pale blue guide lines. A line thickness obtained with a 0.4 mm Rotring pen (or equivalent) is desirable. All curves, lines and symbols should be drawn clearly, and of a line thickness and size that allows for a 40–50% reduction in size on final printing. Axes should not extend appreciably beyond the curves, and it is often unnecessary for an axis scale to start at 0; only the part of the scale relevant to the curves should be given.

The preferred symbols for experimental points are ○, □, △, ●, ■, ▲. The same symbols must not be used on two curves where the points might be confused; subject to that limitation, however, the same symbols should, if possible, be used for the same entities throughout a paper. Individual curves may also be distinguished by distinctive line forms (e.g. —— and – – – –) or by single-letter labels or by brief explanatory labels (see below).

Illustrations for reproduction are reduced photographically and their width should not exceed 17 cm (for illustrations intended to be single-column width) or 35 cm (for illustrations intended to be double-column width). A margin of at least 3 cm is essential.

Final lettering on figures will be done by the printer. It is therefore sufficient for authors to insert clear guide lettering on

a photocopy of the figure. The addition of carefully drawn lettering in black ink is not necessary but is permissible.

Authors are encouraged to use brief explanatory labels within a figure if it is thereby more readily understood and if the labels can be inserted without requiring a larger figure. The final lettering of such labels will, again, be done by the printer.

**Histograms.** Simple histograms recording only a few values will not be published. The information can be given more concisely as a table or as a sentence or two in the text.

**Sequence diagrams.** Amino acid and nucleotide sequences are often printed in a form that requires careful vertical alignment. Authors should submit such sequence diagrams in camera-ready form, thereby avoiding the misalignments that can be introduced by typesetting and obviating the need for proof-reading of large arrays of complex information. Such diagrams should be prepared with an electric typewriter or 'letter-quality' computer printer; any additional markings should be added carefully in black ink.

**Half-tone illustrations (photographs).** Half-tone illustrations will be reproduced on text paper. Glossy prints are required, and it is helpful if the prints supplied are trimmed to the intended reproduction size (i.e. to fit within the page area). Where the magnification is to be indicated (e.g. on electron micrographs), this should be done by adding a bar representing a stated length.

**Colour plates.** These are accepted when, in the opinion of the Editorial Board, they are essential to illustrate a particular scientific point. Authors will normally be required to pay the full cost of such plates (approximately £900 per plate at 1991 prices).

### Isotope experiments

Where possible, radioactivity should be expressed in absolute terms, i.e. curies (Ci) or becquerels (Bq; disintegrations/s).

### Mass spectrometry

Full mass spectra are often not published, but the editors may wish to see these. If deemed necessary, full spectra may be deposited with the British Library Document Supply Centre (see the Deposition of data section on p. 5).

Spectra may be described as, e.g. '$m/z$ 300 [$M^+$ (the molecular ion)], 282 ($M^+ - H_2O$) etc.'. If parenthetic values are quoted for percentage peak heights, it should be stated what these are relative to.

### Micro-organisms

In the title, in the synopsis and at the first mention in the text, micro-organisms should be given their full binominal Latin name, which will be printed in italics (e.g. *Escherichia coli*). Each organism should preferably have been obtained from or deposited with a recognized collection of micro-organisms, and the collection number must be given. Alternatively, a strain number or name should be quoted; this should not be underlined. Names of ranks higher than genus (e.g. Eubacteriales, Lactobacilleae), generic names used adjectivally (e.g. 'staphylococcal') and names of micro-organisms used colloquially (e.g. as in 'most lactobacilli behave thus') are not italicized. The first (i.e. generic) name should be spelt with a capital letter. Elsewhere in the text, single-letter abbreviations may be given for the generic name; if two genera with the same initial letter are studied, abbreviations such as *Strep.* and *Staph.* may be used.

Great care is needed in verifying the identities of micro-organisms, and authors should bear in mind that the value of their work may be limited if material is wrongly named. Many major culture collections of micro-organisms are able to verify identifications. Authors are urged to deposit new organisms in pertinent culture collections so that they may be readily available to other workers.

Recommendations on nomenclature in bacterial genetics have been proposed by M. Demerec, E. A. Adelberg, A. J. Clark & P. E. Hartman [(1966) Genetics **54**, 61–76]. Authors should follow these guide-lines wherever appropriate. Genetic designations for various micro-organisms are listed in Genetic Maps (edited by S. J. O'Brien), Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.

The following reference books may be found useful.

Bergey's Manual of Systematic Bacteriology, vols. 1–4, Williams & Wilkins, Baltimore, MD.

Ainsworth and Bisby's Dictionary of the Fungi, 7th edn., by D. L. Hawksworth, B. C. Sutton & G. C. Ainsworth, Commonwealth Agricultural Bureau, Slough.

The Yeasts, a Taxonomic Study, 3rd edn. (edited by N. J. W. Kreger-van Rij), Elsevier, Amsterdam.

### Molecular mass and the dalton

There are two preferred ways of specifying the mass of a biochemical entity. 'Relative molecular mass' ($M_r$; *not* 'molecular weight') is the ratio of the mass of a molecule to $\frac{1}{12}$ of the mass of the nuclide $^{12}C$; it is thus dimensionless. 'Molecular mass' is the mass of one molecule of a substance expressed in daltons (symbol Da) or atomic mass units; the dalton is defined as $\frac{1}{12}$ of the mass of one atom of $^{12}C$.

Thus a protein may be said to have a relative molecular mass of 50000 ($M_r = 50000$) or a molecular mass of 50000 Da (more conveniently, 50 kDa), and may be referred to as the 50000-$M_r$ protein or the 50 kDa protein. It is *not* correct to express $M_r$ in daltons or to use K to represent $M_r$ 1000 or 1 kDa. Either '$M_r$' or 'molecular mass (kDa)' should be used consistently throughout a single paper.

### Nucleotide sequences

Authors should note that nucleotide sequences should be fully determined in both senses of the DNA. An explicit statement to this effect and a supporting diagram summarizing the sequence data would normally be sufficient evidence.

Authors of papers containing primary nucleotide sequence data are required to have deposited their data with the European Molecular Biology Laboratory Data Library (EMBL) or with an associated data library before their paper can be published. The database accession number provided by EMBL will be included in the published paper. Data can be deposited and an accession number obtained before submission of the paper; alternatively, on acceptance of a paper containing such data and where no accession number is provided, the editorial office will send the authors a data submission form. The authors should return the completed form, together with the sequence data in computer-readable format or as computer printout, direct to EMBL who will allot an accession number that can be written into the proofs of the paper.

A memorandum on data submission, and data submission forms, are available from the editorial office.

### Plants

The full binominal Latin names should be included for all plant species. Where appropriate, the variety and the source should be specified.

### Powers in tables and figures

Care is needed where powers are used in table headings and in figures in order to avoid numbers with too many digits. The quantity expressed is to be preceded by the power of 10 by which its value has been multiplied. The units in which the quantity is

expressed may not be multiplied by a power of 10; the unit may be changed by the use of prefixes, e.g. m, $\mu$, n or p. For example: (i) an entry '2' under heading $10^3$ *k* means that the value of *k* is 0.002; an entry '2' under heading $10^{-3}$ *k* means that the value of *k* is 2000; (ii) a concentration 0.00015 M may be expressed as 0.15 under heading 'concn. (mM)' *or* as 150 under heading 'concn. ($\mu$M)' *or* as 15 under heading '$10^5 \times$ concn. (M)', but *not* as 15 under heading 'concn. ($M \times 10^{-5}$)'; (iii) complex quantities are treated similarly; a value for 1/[S] of 200 $M^{-1}$ would appear as '2' under the heading $10^{-2}$/[S] ($M^{-1}$) or as '0.2' under the heading 1/[S] ($mM^{-1}$). Square brackets may conventionally be used to indicate concentration.

**Prefixes for multiples and submultiples of units**

These should be as follows:

| Multiple | Prefix | Symbol | Multiple | Prefix | Symbol |
|---|---|---|---|---|---|
| $10^{12}$ | tera | T | $10^{-2}$ | centi | c* |
| $10^9$ | giga | G | $10^{-3}$ | milli | m |
| $10^6$ | mega | M | $10^{-6}$ | micro | $\mu$ |
| $10^3$ | kilo | k | $10^{-9}$ | nano | n |
| $10^2$ | hecto | h* | $10^{-12}$ | pico | p |
| 10 | deka | da* | $10^{-15}$ | femto | f |
| $10^{-1}$ | deci | d* | $10^{-18}$ | atto | a |

* To be avoided where possible (except for cm).

A combination of a prefix and a symbol for a unit is regarded as a single symbol, which may be raised to a power without the use of parentheses or brackets, e.g. $mM^{-1}$ and $cm^2$.

**References**

The Harvard System *or* the Numbering System may be used for the citation of references in the text

**Harvard System.** References should appear as follows: for papers written by one or two authors, as '(Low, 1989)' or 'Hooper & Turner (1989)'; for papers written by three or more authors as 'Relton *et al.* (1983)' or '(Hooper *et al.*, 1987)'. Where more than one paper by the same author(s) has appeared in one year the reference should be given as 'Hooper *et al.* (1990*a*,*b*)'.

At the end of the paper references should be listed in alphabetical order, except for papers by three or more authors (which are given in the text only as '*et al.*'), which should be grouped in chronological order after any other papers by the first author. The authors' initials should be included, but not the title of the paper. The style to be used is shown in the following examples.

Hooper, N. M. & Turner, A. J. (1989) Biochem. J. **261**, 811–818
Hooper, N. M., Low, M. G. & Turner, A. J. (1987) Biochem. J. **244**, 465–469
Hooper, N. M., Keen, J. N. & Turner, A. J. (1990*a*) Biochem. J. **265**, 429–433
Hooper, N. M., Hryszko, J. & Turner, A. J. (1990*b*) Biochem. J. **267**, 509–515

**Numbering system.** References should be cited in the text by sequential numbers in square brackets, e.g. '[1]', '[2–6]', '[4,5,7–10]' etc. At the end of the paper references should be listed in *numerical* order in the same style as described for the Harvard system, preceded by the number. Thus:

1. Hooper, N. M., Hryszko, J. & Turner, A. J. (1990) Biochem. J. **267**, 509–515
2. Hooper, N. M. & Turner, A. J. (1989) Biochem. J. **261**, 811–818
3. Hooper, N. M., Keen, J. N. & Turner, A. J. (1990) Biochem. J. **265**, 429–433
4. Hooper, N. M., Low, M. G. & Turner, A. J. (1987) Biochem. J. **244**, 465–469

**Both systems.** Names and initials of all authors, and first and last page numbers, should be provided for all references. Titles of journals should be abbreviated in accordance with the Chemical Abstracts Service Source Index (1907–1989 Cumulative) (1989) and subsequent Quarterly Supplements (American Chemical Society).

References to books and monographs should be in accordance with the following example.

5. Turner, A. J. & Hooper, N. M. (1990) in Molecular and Cell Biology of Membrane Proteins: The Glycolipid Anchors of Cell-Surface Proteins (Turner, A. J., ed.), pp. 129–150, Ellis Horwood, Chichester

References to a paper 'in the press' are permissible provided that it has been accepted for publication (the name of the journal and documentary evidence of acceptance must be provided):

Smith, A. (1992) Biochem. J., in the press

References to 'personal communication' and 'unpublished work' are permitted in the text only, not in the list of references; for the former citation, documentary evidence from the person quoted showing agreement with the quotation must be provided. A reference to 'unpublished work' must be supported by the names and initials of all involved. The use of 'in preparation', 'private communication' and 'submitted for publication' is not allowed.

Most papers as submitted contain errors in the references; authors should check carefully correspondence between text and list, and the spelling of all names, in the **final version** of the paper. Failure to do so may lead to the paper being returned for correction, with consequent delay in publication.

**Solutions**

Solutions should be described in terms of molarity (M) not normality (N). Fractional concentrations should be expressed in the decimal system, e.g. 0.25 M-HCl (*not* M/4 HCl). The term % must be defined as w/w, w/v or v/v, e.g. 5% (w/v) means 5 g/100 ml. For aqueous solutions of concentration less than 1%, w/v need not be inserted if it is clear that the concentration is stated in terms of weight of solute. For solutions of salts expressed as % it must be made clear whether anhydrous or hydrated compounds are used. It may be noted that SI recommends that the symbol 'M' should be replaced by 'mol/l', and that '% (w/v)' and '% (v/v)' should be given in terms of, e.g., 'g/l' and 'ml/l'. However, the use of 'M', '% (w/v)' and '% (v/v)' will continue to be accepted in the *Biochemical Journal*.

**Buffers.** These must be specified so that readers can reproduce the conditions used by authors. It is often useful to give the complete composition of each solution, e.g. '0.09 M-sodium acetate/0.01 M-acetic acid, pH 5.6' (which means that a single solution has these concentrations of these substances) at the first mention or in the Experimental section. A short designation, e.g. '0.1 M-sodium acetate buffer, pH 5.6', may be used elsewhere throughout the paper. In such designations the concentration specified should be the sum of the concentrations of all forms of the partly ionized species. If a buffer contains two or more partly ionized species (e.g. pyridine and acetic acid) then the concentration of each substance included should be stated.

An initial capital letter should be used for the trivial names of the following buffers, which need not be defined:

| | |
|---|---|
| Aces | 2-[(2-Amino-2-oxoethyl)amino]ethanesulphonic acid |
| Ada | [(Carbamoylmethyl)amino]diacetic acid |
| Bes | 2-[Bis-(2-hydroxyethyl)amino]ethanesulphonic acid |

| | |
|---|---|
| Bicine | *NN*-Bis-(2-hydroxyethyl)glycine |
| Bistris | 2-[Bis-(2-hydroxyethyl)amino]-2-(hydroxymethyl)propane-1,3-diol |
| Hepes | 4-(2-Hydroxyethyl)-1-piperazine-ethanesulphonic acid |
| Hepps | 4-(2-Hydroxyethyl)-1-piperazinepropanesulphonic acid |
| Mes | 4-Morpholine-ethanesulphonic acid |
| Mops | 4-Morpholinepropanesulphonic acid |
| Pipes | 1,4-Piperazinediethanesulphonic acid |
| Taps | 3-{[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]amino}-1-propanesulphonic acid |
| Tes | 2-{[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]-amino}ethanesulphonic acid |
| Tricine | *N*-[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]glycine |
| Tris | 2-Amino-2-hydroxymethylpropane-1,3-diol |

Incubation media such as Krebs–Ringer solution, Eagle's medium, Waymouth's medium etc. should be defined either by reference or by giving the composition.

The symbol for ionic strength (mol/l) is *I*.

## Spectra and spectroscopic data

Full spectra should be published when important or novel features are demonstrated; however, other spectra or spectral information may be deposited with the British Library Document Supply Centre (see the Deposition of Data section on p. 5).

The spectra for u.v. and visible absorption, fluorescence, circular dichroism and optical rotation should have a wavelength scale (e.g. nm or $\mu$m) whether or not a wavenumber scale (e.g. $cm^{-1}$) is given. Where possible, molar terms should be used in absorption, circular dichroism and optical rotation. C.d., e.x.a.f.s., n.m.r. (use when nuclei other than $^1H$ are used), p.m.r., e.s.r. or e.p.r. and o.r.d. are acceptable abbreviations and need not be defined.

**Visible and ultraviolet-absorption spectroscopy.** The general name for the quantity $\log(I_0/I)$ is attenuance, and this reduces to absorbance when there is negligible scattering or reflection. The more general term attenuance should be used when scattering is considerable, e.g. when the quantity is measured to estimate the cell density of a culture. Otherwise the term absorbance should be used; neither should be called extinction or optical density. Symbols used are: *A*, absorbance; *D*, attenuance; *a*, specific absorption coefficient (litre·$g^{-1}$·$cm^{-1}$) (alternatively use $A^{1\%}_{1\,cm}$); $\epsilon$, molar absorption coefficient (numerically equal to the absorbance of a 1 mol/litre solution in a 1 cm light-path) (use units of litre·$mol^{-1}$·$cm^{-1}$ or $M^{-1}$·$cm^{-1}$ and not $cm^2$·$mol^{-1}$). Wavelengths are given in (nm) as subscripts without units, e.g. $A^{1\%}_{1\,cm,\,420}$. No equals sign need be given between $\epsilon$ or *A* and its value.

**Infrared spectroscopy.** Spectra are reported as percentage transmittance, *T*, as a function of wavelength (given in $\mu$m) or frequency (given in $cm^{-1}$). When assigning bands the units need be given for the first value only and the description should be in the style, e.g. '(broad NH band)'.

**Optical rotation.** This is reported as the specific rotation, $[\alpha]^t_\lambda$, which is numerically equal to the rotation in degrees of a 1 g/ml solution with a pathlength of 1 dm (10 cm) at wavelength $\lambda$ and temperature *t*. The concentration (g/100 ml) and solvent are quoted, e.g. '$[\alpha]^{20}_{420}$ −27.5° (*c* 2 in methanol)'.

The corresponding molar expressions for the molar rotation, $[M] = [\alpha] \times M_r$ and $[m] = [\alpha] \times M_r/100$, should be defined.

For biopolymers, the mean residue $M_r$ is used, and $[m]_{m.r.w.}$ is the mean residue rotation. Where a refractive-index correction is applied, $[m']$, the reduced mean residue rotation, is reported. Dimensions of $[m]$ and $[m']$ are degrees·$cm^2$·$dmol^{-1}$.

Optical rotatory dispersion is reported as the variation of $[\alpha]$ or $[m]$ with wavelength (or frequency).

**Circular dichroism.** This is reported as the molar circular-dichroism absorption coefficient $\Delta\epsilon = \epsilon_L - \epsilon_R$ [or the molar ellipticity, $[\theta]$ (see below)]. For biopolymers, molar concentrations in terms of the mean residue $M_r$ are generally used. Units of $\Delta\epsilon$ are the same as for $\epsilon$, i.e. litre·$mol^{-1}$·$cm^{-1}$ or $M^{-1}$·$cm^{-1}$.

Specific ellipticity $[\psi]$, molar ellipticity $[\theta]_M$ and mean residue ellipticity $[\theta]_{m.r.w.}$ are directly analogous to the terms used in optical rotation. The units of $[\theta]$ are as for $[m]$. Note that $[\theta]_M = 3300 \times \Delta\epsilon$.

**Fluorescence spectroscopy.** In reporting fluorescence excitation and emission spectra it should be stated whether intensities, *F*, are relative, normalized or corrected (and the nature of the correction).

Fluorescence-polarization data and spectra are reported as polarization ratio, *P*, or preferably anisotropy ratio, *A*; both are dimensionless.

**Nuclear magnetic resonance.** N.m.r. chemical-shift data, $\delta$, are expressed as parts per million (p.p.m.) and the reference compound must be quoted. The recommended convention is that downfield shifts are positively signed. Coupling constants are expressed in Hz.

For reporting structural n.m.r. data the style suggested is: '$\delta$ (p.p.m.) (solvent) chemical-shift value [integration, peak type, coupling constant (in Hz), designation (relevant proton in *italics*)]'. E.g. '$\delta$ (p.p.m.) [($^2H$)chloroform] 0.92 [6H, d, *J* 6 Hz, $CH(CH_3)$], 2.16 (2 H, t, *J* 7 Hz, $CH_2CH_2CO$)'. Singlet, doublet etc. are abbreviated to s, d etc. without definition, but other descriptions, e.g. broad and overlapping, should be in full.

**Electron spin resonance, electron paramagnetic resonance.** Derivative spectra are given, unless otherwise stated; a scale of the magnetic-field strength (in mT) and/or *g* values should be given. Peaks are described as, e.g., 'the $g = 2$ peak'.

**Mössbauer spectroscopy.** The absorption (in %, arbitrary units or crude channel counts) is plotted against the Doppler velocity, *v* (in mm/s). The chemical shift, $\delta$, in units of mm/s should be quoted relative to a specified standard (e.g. metallic iron at 290 K). The temperature should always be given and the applied magnetic field, if any, should be precisely described.

## Statistical treatment of results

Data from a sufficient number of independent experiments should be reported to permit evaluation of the reproducibility and significance of the results. When the object is to determine the value of a quantity or the statistical characteristics of a population, sufficient information is usually conveyed by the following: (i) the number of independent experiments (replicate measurements in an individual animal or preparation and results from pooled tissues etc. represent only one independent estimate); (ii) the mean value; (iii) the standard deviation (S.D.), the coefficient of variation or the standard error of the estimate of mean value (S.E.M.), as may be appropriate. It should be made clear whether the standard deviation or the standard error is used. A convenient form for inclusion in a table is, for example, $263 \pm 2.5$ (10), where the number in parentheses represents the number of values used in calculating the mean.

When any significance is claimed, the test of significance used should be stated and an estimate of the probability given.

Statistical tests appropriate for a normal distribution will be assumed unless stated otherwise.

## Symbols for physical units

The *Biochemical Journal* uses the recommended SI symbols

for units [see Quantities, Units and Symbols in Physical Chemistry (1988), Blackwell Scientific Publications, Oxford (ISBN 0 632 01773 2)]. Preference should be given to the recommended SI units, e.g. either '42 kJ/mol' or '42 kJ/mol (10 kcal/mol)', is permissible, but not '10 kcal/mol' alone. Details are given below under 'Abbreviations, symbols, conventions and definitions' (pp. 15–19). The symbol for the plural of a unit is the same as that for the singular.

### Tables

Each table should be supplied with an informative heading and an explanatory legend, starting on a new line and typed double-spaced. The heading and legend should make the general meaning comprehensible without reference to the text. Footnotes should be as few as possible, only being used where it is necessary to draw attention to a feature of a particular row, column or value. Conditions specific to the particular experiment should be stated. Reference to the text for general experimental methods is permissible provided that there is no ambiguity. The units in which the results are expressed, e.g. g/100 ml, should be given at the top of each column, and not repeated on each line of the table.

Tables should be typed on separate sheets and their approximate position in the text indicated. Words or numerals should be repeated on successive lines: 'ditto' or '„' are not to be used.

### Trade names

The names and addresses of the manufacturers or suppliers of special apparatus or materials should be given. Wherever possible, the chemical nature of proprietary material should be specified at the first mention.

### Unique biological materials

It is expected that authors will make samples of unique biological materials (including cell lines, DNA clones and antibodies) available to academic workers who request them. Authors are urged to deposit cell lines of more than local interest with appropriate collections at national centres (e.g. in the U.K. at the National Collection of Animal Cell Culture, Centre for Applied Microbiology and Research, Porton Down, Salisbury, Wilts. SP4 0J6, and in the U.S.A. at the American Type Culture Collection, 12301 Parklawn Drive, Rockville, MD 20852).

### X-ray crystallography

Authors of papers describing structure determination by X-ray crystallography are encouraged to deposit, either with the British Library (see p. 5) or, preferably, with the Protein Data Bank (Brookhaven National Laboratory, Upton, NY 11973, U.S.A.), all of the structural data required to validate the proposed structure and its discussion. It should be stated in a footnote to the paper that the necessary data have been deposited. Under certain circumstances the Protein Data Bank may be asked not to release the data until after a date (no more than 4 years after acceptance of the paper) specified by the authors.

Further details of this procedure may be obtained from the editorial office.

# Nomenclature

## BIOCHEMICAL NOMENCLATURE

As far as possible authors should follow the Recommendations of the Nomenclature Committee of IUBMB and the IUPAC–IUBMB Joint Commission on Biochemical Nomenclature.

### General

1. Abbreviations and symbols for chemical names of special interest in biological chemistry: Biochem. J. (1966) **101**, 1–7 (extended by many of the items below).
2. Recommendations for measurement and presentation of biochemical equilibrium data: Biochem. J. (1977) **163**, 1–7.
3. Nomenclature of phosphorus-containing compounds of biochemical importance: Biochem. J. (1978) **171**, 1–19.

### Amino acids, peptides and proteins

4. Nomenclature and symbolism for amino acids and peptides: Biochem. J. (1984) **219**, 345–373.
5. Nomenclature of α-amino acids: Biochem. J. (1975) **149**, 1–16 (replaced by item 4, but Appendices A and B contain an extensive list of naturally occurring amino acids).
6. Abbreviations and symbols for the description of the conformation of polypeptide chains: Biochem. J. (1971) **121**, 577–585.
7. Abbreviated nomenclature of synthetic polypeptides (polymerized amino acids): Biochem. J. (1972) **127**, 753–756.
8. Recommendations for the nomenclature of human immunoglobulins: Biochem. J. (1975) **145**, 21–23.
9. The nomenclature of peptide hormones: Biochem. J. (1975) **151**, 1–4.
10. Nomenclature of electron-transfer proteins: Eur. J. Biochem. (1991) **200**, 599–611.

### Enzymes

11. The nomenclature of multiple forms of enzymes: Biochem. J. (1978) **171**, 37–39.
12. Units of enzyme activity: Eur. J. Biochem. (1979) **97**, 319–320 [for corrections see Eur. J. Biochem. (1980) **104**, 1].
13. Symbolism and terminology in enzyme kinetics: Biochem. J. (1983) **213**, 561–571.
14. Nomenclature for multienzymes: Eur. J. Biochem. (1989) **185**, 485–486.

### Nucleic acids

15. Abbreviations and symbols for nucleic acids, polynucleotides and their constituents: Biochem. J. (1970) **120**, 449–454.
16. Abbreviations and symbols for the description of conformations of polynucleotide chains: Eur. J. Biochem. (1983) **131**, 9–15.
17. Nomenclature for incompletely specified bases in nucleic acid sequences: Biochem. J. (1985) **229**, 281–286.

### Lipids

18. The nomenclature of lipids: Biochem. J. (1978) **171**, 21–35.

19. The nomenclature of steroids: Eur. J. Biochem. (1989) **186**, 429–458.
20. Tentative rules for the nomenclature of carotenoids: Biochem. J. (1972) **127**, 741–752 [for amendments see Biochem. J. (1975) **151**, 5–7].
21. Nomenclature of quinones with isoprenoid side chains: Biochem. J. (1975) **147**, 15–21.
22. Nomenclature of prenols: Eur. J. Biochem. (1987) **167**, 181–184.

**Carbohydrates**

23. Tentative rules for carbohydrate nomenclature, part 1: Biochem. J. (1971) **125**, 673–695.
24. Nomenclature of cyclitols: Biochem. J. (1976) **153**, 23–31 (see also item 32).
25. Nomenclature of unsaturated monosaccharides: Eur. J. Biochem. (1981) **119**, 1–3 [for corrections see Eur. J. Biochem. (1982) **125**, 1].
26. Conformation of 5- and 6-membered ring forms of sugars: Eur. J. Biochem. (1980) **111**, 295–298.
27. Nomenclature of branched-chain monosaccharides: Eur. J. Biochem. (1981) **119**, 5–8 [for corrections see Eur. J. Biochem. (1982) **125**, 1].
28. Polysaccharide nomenclature: Eur. J. Biochem. (1982) **126**, 439–441.
29. Abbreviated terminology of oligosaccharide chains: Eur. J. Biochem. (1982) **126**, 433–437.
30. Symbols for specifying the conformation of polysaccharide chains: Eur. J. Biochem. (1983) **131**, 5–7.
31. Nomenclature of glycoproteins, glycopeptides and peptidoglycans: Eur. J. Biochem. (1986) **159**, 1–6 [for correction see Eur. J. Biochem. (1989) **185**, 485].
32 Numbering of atoms in *myo*-inositol: Biochem. J. (1989) **258**, 1–2.

**Miscellaneous**

33. Trivial names of compounds of importance in biochemistry: Biochem. J. (1967) **102**, 15–16 (but see items 34–37 below).
34. Nomenclature of retinoids: Eur. J. Biochem. (1982) **129**, 1–5 (supersedes M-1 of item 33 above).
35. Nomenclature of vitamin D: Eur. J. Biochem. (1982) **124**, 223–227 (supersedes M-2 of item 33 above).
36. Nomenclature of tocopherols and related compounds: Eur. J. Biochem. (1982) **123**, 473–475 (supersedes M-3 of item 33 above).
37. Nomenclature for vitamins B-6 and related compounds: Biochem. J. (1974) **137**, 417–421 (replaces M-7 of item 33 above).
38. The nomenclature of corrinoids: Biochem. J. (1975) **147**, 1–10.
39. Nomenclature of tetrapyrroles: Pure Appl. Chem. (1987) **59**, 779–832.
40. Nomenclature and symbols for folic acid and related compounds: Eur. J. Biochem. (1987) **168**, 251–253.
41. Nomenclature of initiation, elongation and termination factors for translation in eukaryotes: Eur. J. Biochem. (1989) **186**, 1–3.

Comments on the Recommendations should be sent to the Nomenclature Committee of IUBMB (Secretary: Dr. A. J. Barrett, Strangeways Research Laboratory, Worts Causeway, Cambridge CB1 4RN, U.K.).

**Abbreviations and symbols**

The *Biochemical Journal* follows where possible the recommendations of the IUPAC–IUB Joint Commission on Biochemical Nomenclature (see the preceding section and the summarized information in the following sections).

All abbreviations, except those specifically mentioned below and elsewhere in these Instructions to Authors as not needing definition, should be defined together in a footnote on the title page. Abbreviations (except for those not needing definition) should not be used in the title or page-heading title. Cumbersome names of enzymes used frequently may be abbreviated; any such abbreviation should be based on the EC recommended name, which should be given, together with the EC number, in the footnote.

Abbreviations that may be used without definition are:

| | |
|---|---|
| ADP, CDP, GDP, IDP, UDP, XDP, dTDP | 5′-Diphosphates of adenosine, cytidine, guanosine, inosine, uridine, xanthosine, thymidine |
| AMP etc. | Adenosine 5′-phosphate etc. |
| ATP etc. | Adenosine 5′-triphosphate etc. |
| ATPase etc. | Adenosine triphosphatase etc. |
| BSA | Bovine serum albumin |
| CHAPS | 3-[(3-Cholamidopropyl)-dimethylammonio]-1-propanesulphonic acid |
| CM-cellulose | Carboxymethylcellulose |
| CoA and acyl-CoA | Coenzyme A and its acyl derivatives |
| cyclic AMP etc. | Adenosine 3′,5′-phosphate etc. |
| dansyl | 5-Dimethylaminonaphthalene-1-sulphonyl |
| DEAE-cellulose | Diethylaminoethylcellulose |
| DNA, cDNA | Deoxyribonucleic acid, complementary DNA |
| DNAase | Deoxyribonuclease |
| EDTA | Ethylenediaminetetra-acetate |
| EGTA | $(HO_2C–CH_2)_2N–[CH_2]_2–O–[CH_2]_2–O–[CH_2]_2–N(CH_2–CO_2H)_2$ ['ethylene glycol bis(amino-ethyl ether)tetra-acetate'] |
| FAD | Flavin–adenine dinucleotide |
| FMN | Flavin mononucleotide |
| G-protein | Guanine nucleotide-binding regulatory protein |
| GSH, GSSG | Reduced and oxidized glutathione respectively |
| IgG etc. | Immunoglobulin G etc. |
| NAD* | Nicotinamide–adenine dinucleotide |
| NADP* | Nicotinamide–adenine dinucleotide phosphate |
| NMN | Nicotinamide mononucleotide |
| PAGE | Polyacrylamide-gel electrophoresis |
| PCR | Polymerase chain reaction |
| $P_i$, $PP_i$ | Orthophosphate, pyrophosphate |
| RNA, mRNA, nRNA, rRNA, tRNA† | Ribonucleic acid and messenger, nuclear, ribosomal and transfer RNA species |

* Oxidized and reduced forms of the dinucleotides should be indicated as, for example, *either* $NAD^+$, NADH, or NAD, $NADH_2$, *not* NAD, NADH. The $NAD^+$/NADH form is preferred and has the advantage that NAD can be used when the state of oxidation need not be indicated.

† Specific tRNA species should be given as, for example, alanine tRNA or $tRNA^{Ala}$; tRNA bound to amino acids should be given as, for example, alanyl-tRNA or alanyl-$tRNA^{Ala}$ (note: fMet = formyl-methionyl). sRNA should not be used.

| | |
|---|---|
| RNAase | Ribonuclease |
| SDS | Sodium dodecyl sulphate |

**Symbols for amino acids [see Biochem. J. (1984) 219, 345–373]**

The three-letter symbols may be used in representing polymers or sequences, and in tables and figures; the one-letter symbols are less easily understood and should be used only for comparisons of long sequences. Neither set of symbols need be defined.

| | | |
|---|---|---|
| Alanine | Ala | A |
| Arginine | Arg | R |
| Asparagine | Asn | N |
| Aspartic acid | Asp | D |
| Aspartic acid or asparagine (undefined) | Asx | B |
| Cysteine | Cys | C |
| Cystine (half) | Cys or Cys | — |
| Glutamine | Gln | Q |
| Glutamic acid | Glu | E |
| Glutamic acid or glutamine (undefined) | Glx | Z |
| Glycine | Gly | G |
| Histidine | His | H |
| Hydroxylysine | Hyl | — |
| Hydroxyproline | Hyp | — |
| Isoleucine | Ile | I |
| Leucine | Leu | L |
| Lysine | Lys | K |
| Methionine | Met | M |
| Ornithine | Orn | — |
| Phenylalanine | Phe | F |
| Proline | Pro | P |
| Serine | Ser | S |
| Threonine | Thr | T |
| Tryptophan | Trp | W |
| Tyrosine | Tyr | Y |
| Unknown or 'other' | Xaa | X |
| Valine | Val | V |

In polymers or sequences the three-letter symbols should be joined by hyphens if the sequence is known, or by commas if it is not; e.g.:

Gly-Ile-Gly-Phe(Gly,Tyr,Val,Ser)Leu-Val-Ala

represents an undecapeptide composed of four amino acids whose sequence has been established, four for which the sequence is unknown and then three in known sequence. The glycine on the left carries the free amino group and the alanine on the right the free carboxyl group. The prefix poly or the suffix subscript *n* may accompany these symbols to indicate polymers [see Biochem. J. (1972) **127**, 753–756].

Special considerations apply to the spacing and punctuation of the one-letter symbols [see Biochem. J. (1984) **219**, 366–368].

**Symbols for nucleosides, nucleotides and polynucleotides [see Biochem. J. (1970) 120, 449–454, which also contains symbols for bases (three-letter system), and Biochem. J. (1985) 229, 281–286]**

The symbols for ribonucleosides, which need not be defined, are as follows (the prefix r should be used if there is possible ambiguity):

| | | | |
|---|---|---|---|
| A | Adenosine | C | Cytidine |
| G | Guanosine | T | Ribosylthymine |
| I | Inosine | U | Uridine |
| X | Xanthosine | Ψ | 5-Ribosyluracil (pseudouridine) |

The 2′-deoxyribonucleosides are designated by the same symbols preceded by d, e.g.:

dA 2′-Deoxyribosyladenine
dT 2′-Deoxyribosylthymine (thymidine)

The letter p (for terminal phosphate only) or a hyphen (for phosphodiester group only) to the left of a nucleoside symbol indicates a 5′-phosphate; to the right it indicates a 3′-phosphate, e.g.:

| | |
|---|---|
| pA-G | 5′-Phosphoadenylyl(3′-5′)-guanosine *or* guanylyl(5′-3′)-adenosine 5′-phosphate |
| A-Gp | Adenylyl(3′-5′)guanosine 3′-phosphate |
| d(A-T) | Deoxyadenylyl(3′-5′)thymidine |
| A-G-cyclic-p *or* A-G>p | Adenylyl(3′-5′)guanosine 2′,3′-phosphate |

Other points of attachment may be indicated by numerals, e.g.:

| | |
|---|---|
| A2′-5′G2′p | Adenylyl(2′-5′)guanosine 2′-phosphate |
| A-G-(mixed 2′,3′)-p | A mixture of A-Gp and A-G2′p |

In sequences, oligonucleotides or polynucleotides the phosphate between nucleoside symbols is shown by a hyphen if the sequence is known, or by a comma if it is not; e.g.:

G-A-U($C_2$,U)Gp

indicates a heptanucleotide composed of three nucleotides of known sequence but with a trinucleotide of unknown sequence before the final Gp. The hyphens may be omitted.

For sequences that are repetitive or obscure, shorter forms may be used [see Biochem. J. (1972) **127**, 753–756], e.g.:

| | |
|---|---|
| poly(A) | a simple homopolymer of A |
| poly($A_3$,$C_2$) | random co-polymer of A and C in 3:2 proportions |
| poly[d(A-T)] *or* poly(dA-dT) | alternating co-polymer of dA and dT |
| poly(A,G,C,U) | random co-polymer of A, G, C and U, proportions unspecified |

The prefix co-poly or oligo may replace poly, if desired. An alternative form is, e.g., $A_n$ for poly(A), where the subscript *n* may be replaced by numerals indicating actual size. Similarly, d(A-T)$_n$ etc. may be used for poly(dA-dT) etc. It should be noted that no space follows the prefix 'poly'.

Associated (e.g. hydrogen-bonded) chains, or bases within chains, are indicated by a centre dot (not a hyphen or a plus sign) separating the complete names or symbols; non-associated chains are separated by a plus sign, and unspecified or unknown association by a comma; e.g.:

| | |
|---|---|
| poly(A)·poly(U)* | associated poly(A) and poly(U) |
| poly(G)·2poly(C) *or* $G_n \cdot 2C_n$ | triple-stranded complex of poly(G) and poly(C) in the proportions 1:2 |

* Also 'adenine·thymine base pair' or 'A·T base pair' in the text.

| | |
|---|---|
| poly(dA-dC)·poly-(dG-dT) *or* $(dA\text{-}dC)_n \cdot (dG\text{-}dT)_n$ | associated poly(dA-dC) and poly(dG-dT) |
| poly(A)+poly(U)* | non-associated poly(A) and poly(U) |
| poly(A),poly(U) | poly(A) and poly(U), no definite information on association |

The abbreviations kb (kilobases), nt (nucleotide) and bp (base pair) may be used in discussions of nucleic acid sequences.

The use of a single symbol to designate a variety of possible nucleotides at a single position has become widespread over the past few years. The following set of symbols, applicable to both DNA and RNA, has been recommended. These symbols do not discriminate between DNA and RNA, and the symbol T is used at all positions where U might appear in the RNA. Sequences may be assumed to have a deoxyribose phosphate (DNA) backbone unless otherwise specified; in circumstances where confusion between DNA and RNA is possible the sequence may be prefixed with the lower-case letter d or r.

| | | | |
|---|---|---|---|
| G | guanine | S | G or C |
| A | adenine | W | A or T |
| T | thymine | H | A or C or T |
| C | cytosine | B | G or T or C |
| R | G or A | V | G or C or A |
| Y | T or C | D | G or A or T |
| M | A or C | N | G or A or T or C |
| K | G or T | | |

**Symbols for sugars [see Biochem. J. (1978) 171, 34, and Eur. J. Biochem. (1982) 126, 433–437]**

These are for use only in representing polymers or sequences and in tables and figures, and need not be defined:

| | | | |
|---|---|---|---|
| Ara | Arabinose | Glc | Glucose |
| dRib† | 2-Deoxyribose | Man | Mannose |
| Fru | Fructose | Rib | Ribose |
| Fuc | Fucose | Xyl | Xylose |
| Gal | Galactose | | |

When it is necessary to indicate furanose or pyranose, the letter *f* or *p* after the saccharide symbol may be used: e.g. Rib*f* for ribofuranose.

The following suffixes may be used, also without definition, to indicate derivatives:

| | |
|---|---|
| A | for uronic acid (e.g. GlcA for glucuronic acid, GalA for galacturonic acid) |
| N and NAc | for 2-amino-2-deoxysaccharides and their *N*-acetyl derivatives (e.g. GlcN for glucosamine and GalNAc for *N*-acetylgalactosamine) |

Note: NeuAc or AcNeu suffices for *N*-acetylneuraminate [see Biochem. J. (1978) **171**, 34].

Two systems (the extended or the condensed) exist for the representation of oligosaccharide chains. Either may be used.

In the extended system the configurational symbol (D or L) is included before the symbol for the monosaccharide, and is separated therefrom by a hyphen. The anomeric symbol ($\alpha$ or $\beta$) is included before the configurational symbol and separated therefrom by a hyphen. Between the symbol (abbreviated name) of one monosaccharide group or residue and the next are placed two locants that indicate the respective positions involved in this glycosidic union. These locants are separated by an arrow (directed from the locant corresponding to the glycosyl carbon atom to the locant corresponding to the carbon atom carrying the hydroxyl group involved) and are enclosed in parentheses. The position of a branch is indicated above or below the main chain, with the numerals and an arrow indicating the glycosidic linkage:

$$\alpha\text{-D-Glc}p\text{-}(1\rightarrow4)\text{-}\alpha\text{-D-Glc}p\text{-}(1\rightarrow4)\text{-D-Man}p$$
$$2$$
$$\uparrow$$
$$1$$
$$\beta\text{-D-Xyl}p$$

The hyphens, except that separating the configurational symbol and the symbol for the monosaccharide, may be omitted.

In the condensed system the common configuration and ring size are implied in the symbol. Thus, Glc means D-glucopyranose; Fru, D-fructofuranose; and Fuc, L-fucopyranose. Whenever the configuration or ring size is found to differ from the common one, or is to be emphasized, this may be indicated by using the appropriate symbols from the extended system. The anomeric descriptor indicates the configuration of the glycoside linkage, and is therefore placed before the locant if the direction of the bond is to the right, or after the locant if the direction of the bond is to the left. The two locants are separated by a hyphen. No hyphens are used between the symbol for the sugar and the parentheses indicating the glycosidic bond; such parentheses may be omitted in representing branched oligosaccharides, when parentheses are used to indicate the branches:

$$\text{Glc}\alpha1\text{-}4(\text{Xyl}\beta1\text{-}2)\text{Glc}\alpha1\text{-}4\text{Man}$$

The condensed form may be shortened further by (i) omitting locants of anomeric carbon atoms, (ii) omitting the parentheses around the specifications of linkage, and (iii) omitting hyphens if desired:

$$\text{Glc}\alpha4(\text{Xyl}\beta2)\text{Glc}\alpha4\text{Man}$$

**Symbols for (poly)phosphoinositides and their hydrolysis products [see Biochem. J. (1978) 171, 21–35]**

The following, and their various combinations with appropriate locants, need not be defined:

| | |
|---|---|
| Ptd | phosphatidyl |
| Ins | 1D-*myo*-inositol |
| *P* | phosphate |

Multiple locants should be placed in parentheses, e.g. PtdIns(4,5)$P_2$ symbolizes phosphatidylinositol 4,5-bisphosphate and Ins(1,4,5)$P_3$ symbolizes *myo*-inositol 1,4,5-trisphosphate (*but note* Ins4*P* etc. for the monophosphate).

The alternative ('Chilton') forms (e.g. $PIP_2$ and $IP_3$) may be used if defined; one or the other form should be used consistently throughout a paper.

## CHEMICAL NOMENCLATURE

The IUPAC recommendations on chemical nomenclature should be followed; see IUPAC's Compendium of Chemical Terminology (1987), Blackwell Scientific Publications, Oxford [ISBN 0 632 01765 1 (cloth) or 0 632 01767 8 (limp)], and source documents listed therein.

**Elementary analyses and physical properties**

Standard forms for reporting these are as follows.

The *new compound* (name in italics) had m.p. 175 °C (decomp.), $[\alpha]_D^{22}$ +17±2° (*c* 1.6 in water), light-absorption max. in ethanol

* Also 'A+T content' (and 'A-T sequence'), not 'AT content' (nor 'AT sequence'), in the text.

† Similarly for other 2-deoxy sugars.

226 and 265 mm (ε 2200 and 2500 respectively) (Found: C, 40.8; H, 6.9; N, 11.5; OMe, 26.0; $C_8H_{16}N_2O_6$ requires C, 40.7; H, 6.8; N, 11.9; OMe, 26.3%).

The known compound (name in roman type) had m.p. 178–179 °C, unchanged by admixture with an authentic sample kindly supplied by Dr. Z. (Found: C, 48.6; H, 6.1; OMe, 50.1. Calc. for $C_{10}H_{16}O_7$: C, 48.4; H, 6.4; OMe, 50.0%). *Or*: The known compound had m.p. 178–179 °C. The mixed m.p. with an authentic sample (m.p. 179–181 °C) prepared by the method of X & Y (1932) was 178–180 °C (Found: C, 49.4; H, 3.8; N, 3.9; loss at 100 °C, 5.1. Calc. for $C_{28}H_{22}I_2N_2,2H_2O$: C, 49.7; H, 3.9; N, 4.2; $H_2O$, 5.3%). (If water of crystallization is claimed, evidence should be given, e.g. as loss at 100 °C as above, or the reason why it cannot be given should be explained.)

Distillation of the product gave a middle fraction (0.3 g), b.p. 120 °C/1.9 kPa (15 mmHg), $n_D^{16}$ 1.4767.

### Formulae

Chemical symbols may be used for elements, groups and simple compounds, but authors are advised that the excessive use of chemical symbols may reduce the readability of a paper.

R, R′, R″ (or $R^1$, $R^2$, $R^3$, $R^4$ if more than three) should be used to denote variable substituents in formulae.

$C_{20}$ acid is used to denote an acid containing 20 carbon atoms and C-3 or $C_{(3)}$ to denote the carbon atom numbered 3. $C_{18:0}$, $C_{18:1}$ etc. are used similarly to denote the number of double bonds in an unsaturated fatty acid.

### Ions

These should be represented thus: $Na^+$, $Zn^{2+}$, $Cl^-$, $PO_4^{3-}$.

### Isotopically labelled compounds

The symbol for the isotope introduced is placed in *square* brackets directly attached to the front of the name (word), as in [$^{14}$C]urea. When more than one position in a substance is labelled by means of the same isotope and the positions are not indicated (as below), the number of labelled positions is added as a right-hand subscript, as in [$^{14}C_2$]glycollic acid. The symbol 'U' indicates uniform and 'G' general labelling, e.g. [U-$^{14}$C]glucose (where the $^{14}$C is uniformly distributed among all six positions) and [G-$^{14}$C]glucose (where the $^{14}$C is distributed among all six positions, but not necessarily uniformly); in the latter case it is often sufficient to write simply '[$^{14}$C]glucose'.

The isotopic prefix precedes that part of the name to which it refers, as in sodium [$^{14}$C]formate, iodo[$^{14}C_2$]acetic acid, 1-amino[$^{14}$C]methylcyclopentanol ($H_2N$–$^{14}CH_2$–$C_5H_8$–OH), α-naphth[$^{14}$C]oic acid ($C_{10}H_7$–$^{14}CO_2H$), 2-acetamido-7-[$^{131}$I]iodofluorene, fructose 1,6-[1-$^{32}$P]bisphosphate, D-[$^{14}$C]glucose, 2*H*-[2-$^2$H]pyran, *S*-[8-$^{14}$C]adenosyl[$^{35}$S]methionine. Terms such as '$^{131}$I-labelled albumin' should not be contracted to '[$^{131}$I]albumin' [since native albumin does not contain iodine (but $^{131}$I-albumin can be used)], and '$^{14}$C-labelled amino acids' should similarly not be written as '[$^{14}$C]amino acids' (since there is no carbon in the amino group).

When isotopes of more than one element are introduced, their symbols are arranged in alphabetical order, including $^2$H and $^3$H for deuterium and tritium respectively.

When not sufficiently distinguished by the foregoing means, the positions of isotopic labelling are indicated by Arabic numerals, Greek letters, or prefixes (as appropriate), placed within the square brackets and before the symbol of the element concerned, to which they are attached by a hyphen; examples are [1-$^2$H]ethanol ($CH_3$–$C^2H_2$–OH), [1-$^{14}$C]aniline, L-[2-$^{14}$C]leucine (or L-[α-$^{14}$C]leucine), [*carboxy*-$^{14}$C]leucine, [*Me*-$^{14}$C]isoleucine, [2,3-$^{14}$C]maleic anhydride, [6,7-$^{14}$C]xanthopterin, [3,4-$^{13}$C,$^{35}$S]-methionine, [2-$^{13}$C,1-$^{14}$C]acetaldehyde, [3-$^{14}$C,2,3-$^2$H,$^{15}$N]-serine.

The same rules apply when the labelled compound is designated by a standard abbreviation or symbol, other than the atomic symbol, e.g. [γ-$^{32}$P]ATP.

For simple molecules, however, it is often sufficient to indicate the labelling by writing the chemical formulae, e.g. $^{14}CO_2$, $H_2{}^{18}O$, $^2H_2O$ (not $D_2O$), $H_2{}^{35}SO_4$, with the prefix superscripts attached to the proper atomic symbols in the formulae. The square brackets are not to be used in these circumstances, nor when the isotopic symbol is attached to a word that is not a chemical name, abbreviation or symbol (e.g. '$^{131}$I-labelled').

### Isotopically substituted compounds

The attention of authors is drawn to the distinction between 'isotopically labelled' and 'isotopically substituted' compounds [see Eur. J. Biochem. (1978) **86**, 9–25].

### Naming compounds

All chemical names are run together except for those of acids, acetals, esters, ethers, glycosides, ketones and salts, which are printed as separate words; hyphens are used to separate numbers, Greek letters or some configurational and italic prefixes from words, e.g. *m*-dinitrobenzene, *ββ*-dimethyl-D-cysteine, 2-*p*-isopropylphenylheptane, ethyl methyl ketone (butan-2-one).

### Optically active isomers

Names of chiral compounds whose absolute configuration is known may be differentiated by the prefixes *R*- and *S*- [see Pure Appl. Chem. (1976) **45**, 11–30]. When the compounds can be correlated sterically with glyceraldehyde, serine or other standard accepted for a specialized class of compound, small capital letters D-, L- and DL- may be used for chiral compounds and their racemates. Where the direction of optical rotation is all that can be specified, (+)-, (−)- and (±)-, or *dextro*, *laevo* and 'optically inactive', are used.

### Prefixes

Italics are used for certain prefixes, e.g. *cis*-, *trans*-, *o*-, *m*-, *p*-, *dextro*, *laevo*, *meso*, and also for *O*-, *N*- etc. to indicate an element carrying a substituent, e.g. $N^4$- acetylsulphanilamide. Italics are not used for allo, bis, cyclo, epi, iso, neo, nor, tris.

An alphabetical order will be followed for prefixes denoting substituents. Syllables indicating multiple substituents, e.g. di-, tri-, do not count in deciding the order.

# Abbreviations, symbols, conventions and definitions

This list includes accepted symbols and abbreviations and also serves as an index; definitions are included that may be of help to authors. See also the lists of relevant documents (pp. 10–14).

| | |
|---|---|
| abbreviations | pp. 11–13 |
| absorbance | $A = \log(I_0/I)$ (*see* p. 9) |
| absorption coefficient, molar | $\epsilon$ (*see* p. 9) |
| acceleration due to gravity ($9.81\ m \cdot s^{-2}$) | $g$ (*see* pp. 4–5) |
| adenosine 3′,5′-phosphate | cyclic AMP |
| adenosine 5′-phosphate | AMP |
| adenosine 5′-diphosphate | ADP |
| adenosine triphosphatase | ATPase |
| adenosine 5′-triphosphate | ATP; the three phosphorus atoms are distinguished as $\alpha$, $\beta$ and $\gamma$, thus: adenosine–$P^{\alpha}$–O–$P^{\beta}$–O–$P^{\gamma}$ |
| alternating current | a.c. |
| amino acids, symbols for | p. 12 |
| ampere | A |
| angstrom | Å (SI units preferred: 1 Å = 0.1 nm) |
| approximately | approx. (before numerical values only, *or use* about, *not c. or ca.*) |
| aqueous | aq. |
| ascorbic acid | *alternative permitted* vitamin C |
| atmosphere | atm (*use* SI units: 1 atm = 101325 Pa) |
| attenuance | $D = \log(I_0/I)$ (*see* p. 9) |
| atto ($10^{-18}\times$) | a (prefix) |
| bar (pressure) | bar (*use* SI units: 1 bar = $10^5$ Pa) |
| base pair | bp |
| becquerel ($s^{-1}$) | Bq |
| boiling point | b.p. |
| bovine serum albumin | BSA |
| buffers | pp. 8–9 |
| calciferol | *use* ergocalciferol, ercalciol or vitamin $D_2$ |
| calculated | calc. |
| *calorie, I.T. | $cal_{IT}$ (*use* SI units: 1 $cal_{IT}$ = 4.1868 J) |
| *calorie, thermochemical | $cal_{th}$ (*use* SI units: 1 $cal_{th}$ = 4.184 J) |
| candela | cd |
| capric acid | *use* decanoic acid |
| caproic acid | *use* hexanoic acid |
| caproyl | *use* hexanoyl |
| capryl, caprinoyl | *use* decanoyl |
| caprylic acid | *use* octanoic acid |
| caprylyl, capryloyl | *use* octanoyl |
| carbobenzoxy | *use* benzyloxycarbonyl |
| carboxymethylcellulose | CM-cellulose |
| catalytic-centre activity | number of molecules of substrate transformed/s per catalytic centre |
| centi ($10^2\times$) | c (*prefix*) (*see* p. 8) |
| centimetre | cm |
| centrifuging | pp. 4–5 |
| cholecalciferol | *alternative permitted* calciol or vitamin $D_3$ |
| chromatography | p. 5 |
| circular dichroism (*see also* ellipticity) | c.d. ($\Delta\epsilon$) (*see* p. 9) |
| coefficient of variation | standard deviation/mean value (*see* p. 9) |
| coenzyme A and its acyl derivatives | CoA and acyl-CoA |
| compare | cf. |
| concentrated | conc. |
| concentration | concn. |
| concentration (symbol, e.g. in specific rotation) | $c$ |
| concentration giving half-maximal response (inhibition) | $EC_{50}$ ($IC_{50}$) |
| constant, equilibrium | $K$ |
| constant, velocity | $k$ (*see* p. 6) |
| coulomb (s·A) | C |
| counts/min, counts/s | c.p.m., c.p.s. |
| cubic | cu. *or as* e.g. $mm^3$ |
| curie ($3.7\times10^{10}\ s^{-1}$) | Ci |
| cycles per second | Hz |
| cytidine 5′-phosphate | CMP |
| cytidine 5′-diphosphate | CDP |
| cytidine 5′-triphosphate | CTP |
| dalton ($\frac{1}{12}$ of the mass of one atom of nuclide $^{12}C$, i.e. $1.663\times10^{-24}$ g) | Da (*see* p. 7) |
| data (N.B.: plural) | *use only* in the sense of 'information given' |
| data, deposition of | p. 5 |
| deci ($10^{-1}\times$) | d (prefix) (*see* p. 8) |
| decomposition (m.p.) | decomp. |
| degrees Celsius ($t/°C = T/K - 273.15$) | °C |

* The symbol 'cal' may be used where the degree of accuracy does not justify distinction between $cal_{IT}$ and $cal_{th}$.

| | |
|---|---|
| degrees Kelvin | K (*not* °K) |
| deka (10×) | da (prefix) (*see* p. 8) |
| density | $\rho$ (g/ml) |
| density, relative | $d$ |
| deoxy (prefix) | *not* desoxy; symbol d |
| deoxyribonuclease | DNAase |
| deoxyribonucleic acid | DNA |
| deoxyribonucleosides, symbols for | p. 12 |
| diethylaminoethylcellulose | DEAE-cellulose |
| diffusion coefficient | $D$, $D^0$, $D_{20,w}$ etc. (*as for* sedimentation coefficient) (*see* p. 5) |
| 5-dimethylamino-naphthalene-1-sulphonyl | dansyl |
| direct current | d.c. |
| disintegrations/min, disintegrations/s | d.p.m., d.p.s. |
| dissociation constant, minus log of | p$K$, *plural* p$K$ values |
| disulphide group | *alternative permitted* S–S |
| dithionite (sodium) | $Na_2S_2O_4$, *not* hydrosulphite, hyposulphite |
| dry ice | *use* solid $CO_2$ |
| dyne | dyn (*use* SI units: 1 dyn = $10^{-5}$ N) |
| electrode potential, standard | $E_0$ |
| electrode potential, standard at given pH | $E'_0$ |
| electromotive force | e.m.f. |
| electron spin resonance, electron paramagnetic resonance | e.s.r., e.p.r. |
| electronvolt ($\approx 1.6022 \times 10^{-19}$ J) | eV |
| electrophoretic mobility ($m^2 \cdot s^{-1} \cdot V^{-1}$) | $m$ (*see* p. 5) |
| elementary analyses | pp. 13–14 |
| ellipticity (*see also* circular dichroism) | $[\theta] = 3300\ \Delta\epsilon$ (*see* p. 9) |
| enthalpy (change) | $\Delta H$ ($kJ \cdot mol^{-1}$) |
| entropy (change) | $\Delta S$ ($kJ \cdot mol^{-1} \cdot K^{-1}$) (*not* e.u.) |
| enzyme-linked immunosorbent assay | e.l.i.s.a. |
| enzyme units | pp. 5–6 |
| equation | eqn. |
| erg | erg (*use* SI units: 1 erg = $10^{-7}$ J) |
| ethylenediaminetetra-acetate | EDTA |
| 'ethylene glycol bis-(aminoethyl ether)tetra-acetate' $(HO_2C–CH_2)_2N–[CH_2]_2–O–[CH_2]_2–O–[CH_2]_2–N(CH_2–CO_2H)_2$ | EGTA |
| experiment (with reference numeral) | Expt.; *plural* Expts. |
| extended X-ray absorption fine structure | e.x.a.f.s. |
| extinction | $\log(I_0/I)$ (*see* p. 9); *use* absorbance |
| farad ($m^{-2} \cdot kg^{-1} \cdot s^4 \cdot A^2 = A \cdot s \cdot V^{-1} = C \cdot V^{-1}$) | F |
| Faraday (quantity of electricity associated with 1 g-equiv. of chemical change) | $F$ |
| fast protein liquid chromatography | f.p.l.c. |
| fatty acids | p. 14 |
| femto ($10^{-15}$×) | f (prefix) |
| figure (with reference numeral) | Fig.; *plural* Figs. |
| figures, preparation of | pp. 6–7 |
| flavin–adenine dinucleotide | FAD |
| flavin mononucleotide | FMN |
| fluorescence anisotropy | $A$ (*see* p. 9) |
| fluorescence polarization | $P$ (*see* p. 9) |
| foot | ft (*use* SI units: 1 ft = 0.3048 m) |
| formulae | p. 14 |
| free energy (Gibbs) (change) | $\Delta G$ ($kJ \cdot mol^{-1}$) |
| frictional coefficient (molar) | $f$ |
| frictional coefficient (molar) for sphere of same volume | $f_0$ |
| gas constant per mole | $\boldsymbol{R}$ |
| gas-liquid chromatography | g.l.c. |
| gauss | G (*use* SI units: 1 G = $10^{-4}$ T) |
| giga ($10^9$×) | G (prefix) |
| glutathione, oxidized | GSSG |
| glutathione, reduced | GSH |
| α-glycerophosphate | *use sn*-glycerol 3-phosphate when the configuration is to be specified |
| gram | g |
| gram-atom | mol preferred, otherwise g-atom |
| gram-molecule | mol |
| gravitational field, unit of (in centrifuging) ($9.81\ m \cdot s^{-2}$) | $\boldsymbol{g}$ (*see* pp. 4–5) |
| gray ($m^2 \cdot s^{-2} = J \cdot kg^{-1}$) | Gy |
| guanine nucleotide-binding regulatory protein | G-protein |
| guanosine 3′,5′-phosphate | cyclic GMP |
| guanosine 5′-phosphate | GMP |
| guanosine 5′-diphosphate | GDP |
| guanosine 5′-triphosphate | GTP |
| haem, protohaem | prosthetic group of haemoglobin |

| | |
|---|---|
| hecto ($10^2\times$) | h (prefix) (*see* p. 8) |
| henry ($m^2\cdot kg\cdot s^{-2}\cdot A^{-2} = V\cdot A^{-1}\cdot s$) | H |
| hertz ($s^{-1}$) | Hz |
| high pressure (or high performance) liquid chromatography | h.p.l.c. |
| Hill coefficient | *h* (*not n*) |
| hour (3600 s) | h |
| hydrogen ion concentration, minus log of | pH, *plural* pH values |
| hydrosulphite, hyposulphite | *not used*, *see* dithionite |
| illustrations | pp. 6–7 |
| immunoglobulin | IgG etc. |
| inch | in (*use* SI units: 1 in = $2.54\times10^{-2}$ m) |
| infrared | i.r. |
| inhibitor constant | $K_i$ (dissociation constant of inhibitor–enzyme complex) |
| inosine 5′-phosphate | IMP |
| inosine 5′-diphosphate | IDP |
| inosine 5′-triphosphate | ITP |
| international unit | i.u. |
| ionic strength (mol/l) | *I* |
| ions | p. 14 |
| isoelectric point (the pH at which a molecule has no effective charge) | pI |
| isoenzyme | *not* isozyme |
| isotonic | *use* iso-osmotic and specify composition of solution, e.g. 0.9% NaCl solution |
| isotopically labelled compounds | p. 14 |
| joule ($m^2\cdot kg\cdot s^{-2} = N\cdot m$) | J |
| katal (amount of enzyme that can catalyse the transformation of 1 mol of substrate/s under conditions specified) | kat (*see* pp. 5–6) |
| kelvin | K (not °K) |
| keto acid | keto used only generically, *otherwise* oxo |
| keto sugars | *use* pentulose, hexulose etc., *not* ketopentose, ketohexose etc. |
| kilo ($10^3\times$) | k (prefix) |
| kilobases | kb |
| kilogram | kg |
| Krebs–Ringer solution | reference to be given |
| light petroleum | *not* petroleum ether; boiling range to be stated |
| litre ($10^{-3}$ m$^3$ = dm$^3$) | l; where there is the possibility of confusion between the numeral '1' and the letter 'l', litre should be written in full |
| logarithm (base 10) | log |
| logarithm (base e) | ln |
| lumen (cd·sr) | lm |
| lux ($m^{-2}\cdot cd\cdot sr$) | lx |
| mass spectrometry | m.s. |
| maximum | max. |
| maxwell | Mx (*use* SI units: 1 Mx = $10^{-8}$ Wb) |
| median effective dose | $ED_{50}$ |
| median lethal dose | $LD_{50}$ |
| mega ($10^6\times$) | M (prefix) |
| melting point | m.p. |
| metabolic quotients | metabolic quotients should be given as mol/s or $\mu$mol/min for a defined arbitrary quantity of material, e.g. mg dry wt., mg of protein, g wet wt. etc. |
| methanol, methanolic | *not* methyl alcohol |
| metre | m |
| Michaelis constant | $K_m$ (*see* p. 6) |
| micro ($10^{-6}\times$) | $\mu$ (prefix) |
| microgram | $\mu$g |
| microlitre | $\mu$l |
| micromicro ($10^{-12}\times$; pico) | p (prefix); *not* $\mu\mu$ |
| *micromolar (concentration) | $\mu$M *or* $\mu$mol/l |
| micromole | $\mu$mol; *not* $\mu$M |
| micron ($10^{-6}$ m) | $\mu$m; *not* $\mu$ |
| milli ($10^{-3}\times$) | m (prefix) |
| milliequivalent | mmol *or* mequiv. |
| milligram | mg |
| millilitre | ml |
| millimetre of mercury (conventional) pressure | mmHg (*use* SI units: 1 mmHg ≈ 133.3 Pa) |
| millimicro ($10^{-9}\times$; nano) | n (prefix); *not* m$\mu$ |
| millimicron ($10^{-9}$ m) | nm; not m$\mu$ |
| *millimolar (concentration) | mM *or* mmol/l |
| millimole | mmol; *not* mM |
| minimum | min. |
| minute (60 s) | min |
| *molar (concentration) | M *or* mol/l |
| mole | mol |
| molecular mass | *see* p. 7 |
| molecular weight | use 'relative molecular mass' (symbol $M_r$) (*see* p. 7) |
| nano ($10^{-9}\times$) | n (prefix) |
| newton ($m\cdot kg\cdot s^{-2} = J\cdot m^{-1}$) | N |
| nicotinamide–adenine dinucleotide | NAD |
| nicotinamide–adenine dinucleotide, oxidized | $NAD^+$ |

* Separated by a hyphen (and no full stop) from a chemical formula or name following it, e.g. 1 M-NaCl; 1 M-NaOH; 1 M-sulphuric acid.

| | |
|---|---|
| nicotinamide–adenine dinucleotide, reduced | NADH |
| nicotinamide–adenine dinucleotide phosphate | NADP |
| nicotinamide–adenine dinucleotide phosphate, oxidized | $NADP^+$ |
| nicotinamide–adenine dinucleotide phosphate, reduced | NADPH |
| nicotinamide mononucleotide | NMN |
| nuclear magnetic resonance | n.m.r. |
| nucleoside (unspecified) | N (*not* X) |
| nucleosides, nucleotides and polynucleotides, symbols for | pp. 12–13 |
| nucleotide | nt |
| number (in enumerations) | no. |
| observed | obs. |
| ohm ($m^2 \cdot kg \cdot s^{-3} \cdot A^{-2} = V \cdot A^{-1}$) | Ω |
| optical rotation | specific optical rotation (with concn. 1 g/ml, light-path 10 cm), e.g. $[\alpha]_D^{20}$, $[\alpha]_{5461}^{25}$<br>molecular optical rotation (= $[\alpha]_\lambda^t \times M_r$), e.g. $[M]_D^{20}$, $[M]_{5461}^{20}$. If a different value, e.g. $[\alpha]_\lambda^t \times M_r/100$, is used, this should be stated |
| optical rotatory dispersion | o.r.d. |
| optically active isomers | p. 15 |
| orthophosphate (inorganic) | $P_i$ |
| osmolar | osM *or* osmol/l (the concentration producing an osmotic pressure equal to that of a molar solution of a perfect solute) |
| page, pages | p., pp. |
| partial specific volume | $\bar{v}$ |
| partition coefficient (dimensionless) | $\alpha$ or $K_D$ |
| parts per million | p.p.m. |
| pascal ($m^{-1} \cdot kg \cdot s^{-2} = N \cdot m^{-2} = J \cdot m^{-3}$) | Pa |
| per | / |
| per cent | % |
| petroleum ether | *not used* (*see* light petroleum) |
| phosphatide | *use* phospholipid |
| phosphoinositides, symbols for | *see* p. 13 |
| pico ($10^{-12}\times$) | p (prefix) |
| poise | P (*use* SI units: 1 P = $10^{-1}$ Pa·s) |
| polyacrylamide-gel electrophoresis | PAGE |
| polymerase chain reaction | PCR |
| potential difference | p.d. |
| pound | lb (*use* SI units: 1 lb ≈ 0.4536 kg) |
| pound-force per square inch | $lbf/in^2$ (*use* SI units: 1 $lbf/in^2$ ≈ 6.9 kPa) |
| precipitate | ppt. |
| preparation | prep. |
| probability of an event's being due to chance alone | *P* |
| proton magnetic resonance | p.m.r. |
| pyridoxine, pyridoxal | *alternative permitted* vitamin B-6 [*see* Biochem. J. (1974) **137**, 417–421] |
| pyrophosphate (inorganic) | $PP_i$ |
| rad ($10^{-2}$ J·$kg^{-1}$) | rad *or* rd (Gy preferred) |
| radian | rad |
| references | p. 8 |
| refractive index | *n*: at stated temperature and wavelength represent as, e.g., $n_D^{20}$ |
| relative band speed (partition chromatography) | *R*, $R_F$, $R_X$ (see p. 5); plural *R* values etc. |
| relative molecular mass | $M_r$ (*see* p. 7) |
| reprints | pp. 4–5 |
| revolutions | rev. |
| rev./min | *not* r.p.m.; *use* **g** where possible (*see* p. 4) |
| riboflavin | *alternative permitted* vitamin $B_2$ |
| ribonuclease | RNAase |
| ribonucleic acid | RNA |
| ribonucleosides, symbols for | p. 12 |
| röntgen ($2.58 \times 10^{-4}$ C·$kg^{-1}$) | R |
| second (time) | s |
| sedimentation coefficient | *s*; *not* sedimentation constant (*see* p. 5) |
| sedimentation coefficient corrected to 20 °C in water | $s_{20,w}$; $s_{20}$ may be used if it is unambiguous (*see* p. 5) |
| sedimentation coefficient at zero concentration | $s^0$, $s^0_{20,w}$ etc. (*see* p. 5) |
| siemens ($m^{-2} \cdot kg^{-1} \cdot s^3 \cdot A^2 = \Omega^{-1} = A \cdot V^{-1}$) | S |
| sievert [(J·$kg^{-1}$) × quality factor] | Sv |
| sodium dodecyl sulphate | SDS |
| soluble | sol. |
| solution | soln. |
| solution, concentration of | p. 8 |
| solvent systems | e.g. butan-1-ol/acetic acid/water (4:1:1, by vol.), butan-1-ol/acetic acid (4:1, v/v) |
| species (singular and plural) | sp., spp. |
| square | sq. *or as* e.g. $cm^2$ |

| | |
|---|---|
| standard deviation | S.D. |
| standard error of estimate of mean value | S.E.M. } *see* p. 9 |
| standard temperature and pressure | s.t.p. |
| statistical treatments | pp. 9 |
| steradian | sr |
| stokes | St (*use* SI units: 1 St = $10^{-4}$ $m^2 \cdot s^{-1}$) |
| substituents (variable, in organic compounds) | R, R′, R″, *or* $R^1$, $R^2$, $R^3$, $R^4$ (if more than three) (*see* p. 14) |
| substrate constant | $K_s$ (dissociation constant of substrate–enzyme complex) |
| sugars, symbols for | p. 13 |
| sulphydryl | *use* thiol *or* SH |
| sum | $\Sigma$ |
| Svedberg unit ($10^{-13}$ s) | S (*see* p. 5) |
| tables (preparation of) | p. 10 |
| temperature | (abbreviation) temp.; (symbol) $t$ (empirical), $T$ (absolute) |
| tera ($10^{12}\times$) | T (prefix) |
| tesla ($kg \cdot s^{-2} \cdot A^{-1} = V \cdot s \cdot m^{-2} = Wb \cdot m^{-2}$) | T |
| thiamin | *alternative permitted* vitamin $B_1$ |
| thin-layer chromatography | t.l.c. |
| thymidine 5′-phosphate | dTMP |
| thymidine 5′-diphosphate | dTDP |
| thymidine 5′-triphosphate | dTTP |
| time (symbol) | $t$ |
| tocopherol | *alternative permitted* vitamin E |
| torr | Torr (*use* SI units: 1 Torr $\approx$ 133.322 Pa) |
| trichloroacetic acid | TCA *not used* |
| turnover number | (of an enzyme) *not used*; *see* catalytic-centre activity |
| ultracentrifuge data | p. 5 |
| ultraviolet | u.v. |
| uridine 3′,5′-phosphate | cyclic UMP |
| uridine 5′-phosphate | UMP |
| uridine 5′-diphosphate | UDP |
| uridine 5′-triphosphate | UTP |
| variety (e.g. botanical) | var. |
| velocity (symbol) | $v$ |
| viscosity, relative | $\eta_{rel.}$ $\left(\frac{\text{viscosity of solution}}{\text{viscosity of solvent}}\right)$ |
| viscosity, specific | $\eta_{sp.}$ (i.e. $\eta_{rel.} - 1$) |
| viscosity, reduced | $\eta_{sp.}/c$ (units: ml/g) |
| viscosity, intrinsic | $[\eta]$, i.e. $\lim_{c \to 0} \eta_{sp.}/c$ |
| volt ($m^2 \cdot kg \cdot s^{-3} \cdot A^{-1} = J \cdot A^{-1} \cdot s^{-1} = J \cdot C^{-1}$) | V |
| volume (abbreviation with number) | vol. |
| v/v | *used only* for two components; by vol. *used* for three or more components |
| watt ($m^2 \cdot kg \cdot s^{-1} = J \cdot s^{-1}$) | W |
| wavelength | $\lambda$ |
| wavelength of $D$ line of sodium (other wavelengths in nm) | D (as subscript) |
| wavenumber (unit) | $cm^{-1}$ |
| weber ($m^2 \cdot kg \cdot s^{-2} \cdot A^{-1} = V \cdot s$) | Wb |
| weight | wt. |
| xanthosine 5′-phosphate | XMP |
| xanthosine 5′-diphosphate | XDP |
| xanthosine 5′-triphosphate | XTP |