



INTERNATIONAL UNION OF  
PURE AND APPLIED CHEMISTRY

Advancing Chemistry Worldwide

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## A CRITICAL REVIEW OF THE PROPOSED DEFINITIONS OF FUNDAMENTAL CHEMICAL QUANTITIES AND THEIR IMPACT ON CHEMICAL COMMUNITIES

2014/Jun/03

**To all Chemical Societies represented by  
IUPAC National Adhering Organizations**

Dear Sir or Madam:

### INTRODUCTION

In light of the proposed revision of the International System of Units (SI) [1], IUPAC has launched a project with the task to provide a Technical Report containing a critical review of the definitions for the quantity amount of substance and its unit, mole, as well as the related unit of the quantity mass. This letter is to collect opinions and comments by the IUPAC National Adhering Organizations (NAOs) which will be reproduced in the aforementioned Technical Report.

### HISTORY

In 1971, the 14th General Conference of Weights and Measures resolved to define the mole as “the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12...” In addition, “when the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.” This is the current definition of the mole [2].

In 2011, the 24th General Conference of Weights and Measures proposed a revision of the SI. As a consequence of this, the redefinition of the mole is necessary and its magnitude will be set “by fixing the numerical value of the Avogadro constant to be equal to exactly  $6.022\ 14 \times 10^{23}$  when it is expressed in the SI unit  $\text{mol}^{-1}$ .” The symbol X represents one or more additional digits to be added to the numerical value of  $N_A$ . This is the proposed new definition of the mole [3].



Mole is the name of the SI base unit (symbol mol) for the base quantity *amount of substance* (symbol  $n$ ) which is defined in IUPAC documents (e.g. IUPAC Green Book, 3rd Edition, 2nd Printing 2008 [4]) using the expression  $n = N/N_A$ , where  $N$  is the number of entities, and  $N_A$  is the Avogadro constant. Similarly, the SI Brochure (8th Edition 2006 [2]) provides the following definition of the quantity *amount of substance*:

“Amount of substance is defined to be proportional to the number of specified elementary entities in a sample, the proportionality constant being a universal constant which is the same for all samples ... This constant is called the Avogadro constant, symbol  $N_A$  or  $L$  ... the relation is  $n = N/N_A$ . ... the Avogadro constant has the coherent SI unit reciprocal mole.”

## QUESTIONNAIRE

IUPAC NAOs are hereby asked the following:

1. Are you (as NAO representing your members) satisfied with the current definition of the mole?
  - a. YES or NO?
  - b. If NO, please specify in a few sentences why you opted for NO.
  - c. If NO, please provide some suggestion on what to change.
2. Are you (as NAO representing your members) satisfied with the new definition of the mole as proposed by the 24th General Conference of Weights and Measures?
  - a. YES or NO?
  - b. If NO, please specify in a few sentences why you opted for NO.
  - c. If NO, please provide some suggestion on what to change.
3. Are you (as NAO representing your members) satisfied with the current definition of the quantity amount of substance?
  - a. YES or NO?
  - b. If NO, please specify in a few sentences why you opted for NO.
  - c. If NO, please provide some suggestion on what to change.
4. Are you (as NAO representing your members) satisfied with the current name of the quantity amount of substance?
  - a. YES or NO?
  - b. If NO, please specify in a few sentences why you opted for NO.
  - c. If NO, please provide a suggestion for a new name.



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Because of external time-constraints, Chemical Societies represented by IUPAC NAOs are asked to reply no later than 2014/October/01. The replies should be drafted on a letterhead, signed, and sent in as a PDF format to [mole@iupac.org](mailto:mole@iupac.org). The comments will be used towards formulating the IUPAC Technical Report. Those organizations who will reply will be sent an advance draft of the IUPAC Technical Report for further comment and input before submission to *Pure and Applied Chemistry*.

Prof. Dr. Jürgen Stohner FRSC  
Chairman of the Task Group

## REFERENCES

- [1] [http://www.bipm.org/en/si/new\\_si/](http://www.bipm.org/en/si/new_si/)
- [2] [http://www.bipm.org/en/si/si\\_brochure/](http://www.bipm.org/en/si/si_brochure/)
- [3] <http://www.bipm.org/en/CGPM/db/24/1/>
- [4] <http://www.iupac.org/home/publications/e-resources/nomenclature-and-terminology/quantities-units-and-symbols-in-physical-chemistry-green-book.html>