



NRC Publications Archive Archives des publications du CNRC

Understanding isotopic distributions in mass spectrometry [Letter] Meija, J.

This publication could be one of several versions: author's original, accepted manuscript or the publisher's version. / La version de cette publication peut être l'une des suivantes : la version prépublication de l'auteur, la version acceptée du manuscrit ou la version de l'éditeur.

For the publisher's version, please access the DOI link below. / Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

Publisher's version / Version de l'éditeur:

<https://doi.org/10.1021/ed083p1761.2>

Journal of chemical education, 83, 12, 2006-12-01

NRC Publications Record / Notice d'Archives des publications de CNRC:

<https://nrc-publications.canada.ca/eng/view/object/?id=fe23e6c2-2c58-4c43-9c3d-7402d89373ec>

<https://publications-cnrc.canada.ca/fra/voir/objet/?id=fe23e6c2-2c58-4c43-9c3d-7402d89373ec>

Access and use of this website and the material on it are subject to the Terms and Conditions set forth at

<https://nrc-publications.canada.ca/eng/copyright>

READ THESE TERMS AND CONDITIONS CAREFULLY BEFORE USING THIS WEBSITE.

L'accès à ce site Web et l'utilisation de son contenu sont assujettis aux conditions présentées dans le site

<https://publications-cnrc.canada.ca/fra/droits>

LISEZ CES CONDITIONS ATTENTIVEMENT AVANT D'UTILISER CE SITE WEB.

Questions? Contact the NRC Publications Archive team at

PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca. If you wish to email the authors directly, please see the first page of the publication for their contact information.

Vous avez des questions? Nous pouvons vous aider. Pour communiquer directement avec un auteur, consultez la première page de la revue dans laquelle son article a été publié afin de trouver ses coordonnées. Si vous n'arrivez pas à les repérer, communiquez avec nous à PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca.



Letters

Understanding Isotopic Distributions in Mass Spectrometry

The article “Using Punnett Squares to Facilitate Students’ Understanding of Isotopic Distributions in Mass Spectrometry” by Lawrence T. Sein, Jr. (1) is an interesting attempt to promote the understanding of the construction of isotopic distributions at the same time showing an interesting relationship between the isotope patterns and genetic traits. Here I want to bring to your attention an alternative simple graphical tool for obtaining complex isotopic distributions.

It is known that isotope patterns of molecules and ions form according to the binomial expansion (2). The perennial Pascal’s triangle is a graphical form of such an expansion and it is easy to see that the coefficients in the standard Pascal’s triangle resemble the isotope patterns of bromine. Although the use of Pascal’s triangle is widely advocated in textbook explanations of multiplets in ^1H NMR spectra, considerably less attention is paid to the fact that isotopic distributions of molecules can be explained in a similar fashion. As a slight modification of the standard Pascal’s triangle, isotopic distributions can be rendered in the form of cellular automata, which generate complex isotopic patterns in an educationally friendly manner (3).

As an example, the isotope pattern of PbCl_2 can be considered. Lead has three isotopes in a ratio of $\sim 1:1:2$ (^{206}Pb , ^{207}Pb , and ^{208}Pb) and chlorine has two isotopes in a ratio of $\sim 3:1$ (^{35}Cl and ^{37}Cl). The rather complex isotopic distribution of PbCl_2 can be easily obtained as shown in Figure 1. In this process, the isotopic distribution of PbCl_2 is obtained in two consecutive steps: first, the isotopic distribution of Cl_2 is obtained and then the isotopic distribution of Pb is added leading to the PbCl_2 . Such construction of complex isotope patterns captures the very essence of the problem—complex isotope patterns can be generated using very simple rules. As can be seen from the above example, no calculators are needed to obtain the isotopic distribution of PbCl_2 .

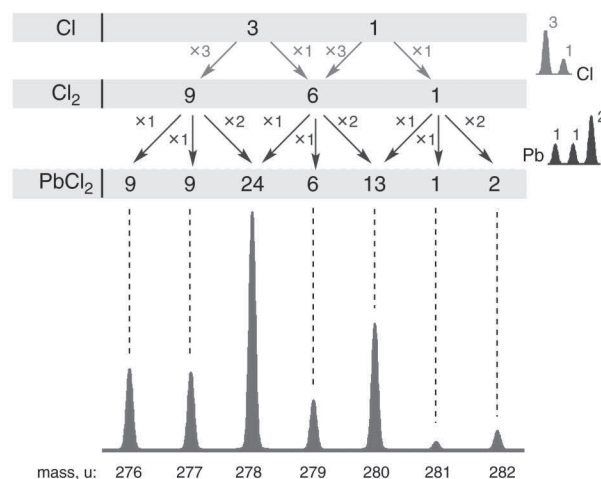


Figure 1. Complex isotopic distribution of PbCl_2 .

Literature Cited

1. Sein, Lawrence T., Jr. *J. Chem. Educ.* **2006**, *83*, 228–232.
2. Margrave, J. L.; Polansky, R. B. *J. Chem. Educ.* **1962**, *39*, 335–337.
3. Meija, J. *Anal. Bioanal. Chem.* **2006**, *385*, 486–499.

Juris Meija

Institute for National Measurement Standards
National Research Council Canada
Ottawa, ON K1A 0R6
juris.meija@nrc-cnrc.gc.ca