letters

Help Asked in Solving Ecological Education Problems in Byelarul

To the Editor:

Within the past several years the world community has rendered great humanitarian assistance to the population of Byelarus, including the Mogilev region, in overcoming the consequences of the Chernobyl catastrophe. The appalling consequences of radiation exposure has been aggravated by the complicated ecological situation that has arisen from unregulated development of the chemical industry and timproper chemical application in agriculture.

These circumstances have awakened widespread chemophobia among the population. Nevertheless, the most reliable way of overcoming these complicated problems is through systematic education to prepare ecologically competent people to do the experimental work and apply it successfully and effectively in all branches of industry.

Unfortunately, our educational system has long produced the opposite—adults do not have the conviction that the majority of of the necessary developments in our material, physiological, and social life must be based on changes coming from chemical science and technology. Naturally, changing this situation is possible only with daily, laborious, long-term, purposeful chemical education of our youth. For this purpose, the first Byelorussian Technological College was founded in Mogilev in 1990. The pupils with talent and inclination toward the natural and technical sciences are training here. The college has a chemical and technological department and a physical and mathematical department and matriculates 100 persons every year. The training process is directed toward a deep and active mastering of ecological knowledge. The professors and senior lecturers of the Molgilev Technological Institute take part in the training process. To graduate, the students must to know one foreign language (English or German) and be able to use the PC. The graduating students become laboratory assistants or PC operators.

We hope that the knowledge and the mode of education produces a deep understanding of the role chemistry and chemical technology play in the environemnt and that the graduating students play an important role in overcoming of our grave ecological situation.

We have supplied the College with modern computer engineering, so we have ensured a stable training process. At the same time, special chemical laboratories are necessary for teaching modern chemical methods. The laboratories should be equipped with modern instrumentation and plants; however, they are not available for purchase in our country, and we have no foreign currency. We temporarily carry out the training process in laboratories of the Mogilev Technological Institute. But their laboratories aren't supplied with modern equipment either.

Within the last two years humanitarian aid has been received by the Republic of Byelarus from different countries. It's important. But the creation of a firm material base for our educational establishment, where the purposeful training of able people is begun, is more important. We appeal to our colleagues of different countries to help us to form the material and technical base of the Mogilev Technological College. We need your assistance in the purchase of complete chemical laboratories.

We would communicate to interested persons the list of chemical equipment and materials we need. We would be grateful for any contributions of literature on chemical educational and methodology (in English or German). It is also very important to establish constant contacts between Mogilev Technological College and analogous educational establishments in other countries, to organize interchange of teachers and students, etc.

Would those interested in helping please contact us at the address below.

B. Geller
O. Polyachenok
G. Roganov
The Technological College Numb. 1
Gagarin St., 58
Mogilev, 212027
Republic of Byelarus

A Revision of the Paper "Grid of Expressions Related to the Einstein Coefficients"

To the Editor,

J. E. Sturm [*J. Chem. Educ.* **1990**, *67*, 32] presents a grid of expressions in SI units relating the Einstein coefficients, oscillator strength, transition dipole moment, and integrated absorption coefficient for a transition between two states. The goal of the paper was praiseworthy and very useful because, as Sturm himself states, a problem situation arises for intermittent practitioners calling on a relation not developed explicitly in the given context, since some of those relations involve reconsideration of not only dimensional but also unit consistency. Effectively, to show the consistency of the expressions used by different textbooks in this context could be a formidable task due to the different notations and units employed and the not very unusual errors that appear in textbooks.

However, Sturm fails in his purpose because some inconsistencies have been introduced in the grid of expressions he suggests. For instance, the expression that relates the oscillator strength (f) with the square of the transition moment (μ^2) is proposed to be:

$$f = \frac{(4\pi\varepsilon_o)8\pi^2 m\omega}{3he^2}\mu^2$$

The right term on this expression should be dimensionless since the oscillator strength is dimensionless. However, if you substitute each magnitude by its SI units you obtain $C^2\ kg\ J^{-2}\ s^{-1}$ units for the right term. In the same way, the relation between the Einstein coefficients, A and B, is proposed to be:

$$A = 8\pi hc\omega^3 B$$

Units of s^{-1} and s kg^{-1} are obtained for A and B, respectively, in the worked example, where A and B are calculated by using the value of the integrated absorption coefficient, $\int \varepsilon\, d\omega$. If you use these units for A and B and substitute the other magnitudes by their SI units you obtain the contradictory result s^{-1} = s. Similar inconsistencies are found in the expressions relating $\int \varepsilon\, d\omega$ and B, μ^2 and A, μ^2 and B, and μ^2 and $\int \varepsilon\, d\omega$.

We believe that most of the inconsistencies observed in Sturm's paper result from the lack of universal criteria and the usual mistakes existing in the literature discussing the subject. For instance, J. M. Hollas (one of the authors referenced by Sturm) proposes the relation between A and B to be:

$$A = 8\pi h\omega^3 B$$

in his book *High Resolution Spectroscopy* (Butherworths, 1982; Chapter 2). In contrast, the same author proposes the relation to be:

$$A = 8\pi hc\omega^3 B$$

in his book *Modern Spectroscopy* (Wiley: New York, 1987; Chapter 2).

In the following table, we present a consistent grid of expressions relating the magnitudes discussed here. In these formulas, SI units are used for all the magnitudes including concentration (mol m^{-3}). We have tried to be coherent with the notation used by Sturm. Anyway, a detailed explanation of the notation employed follows after the table. To derive the expressions appearing in the table, we have mainly used the book *Molecular Quantum Electrodynamics. An Introduction to Radiation–Molecule Interactions* by D. P. Craig and T. Thirunamachandran (Academic Press: New York, 1984). To our knowledge, this book represents one of the first attempts in using SI units to systematize quantum electrodynamics. The formulas presented here are also identical to those obtained by P. W. Atkins in *Molecular Quantum Mechanics* (Oxford University Press: New York, 1984).

E. Ortí and J. Planelles
Secció Departamental de Quimica-Fisica
Col.legi Universitari de Castelló de la Plana
Universitat de Valéncia
Apartat 224, Castelló de la Plana 12080, Spain

To the Editor:

I am grateful for the favorable response by Ortí and Planelles to the theme of my paper [**1990**, *67*, 32]. We agree that a grid or table of expressions related to the Einstein coefficients is desirable. Their letter indicating errors was nevertheless disquieting since one tries to avoid errors especially in manuscripts for publication. My examples in the text of my paper are dimensionally correct for oscillator strength, f, dipole moment integral, μ^2, and the Einstein A_{km} coefficient. We differ in two respects that affect some, but not all, of the relationships:

1. Dimensions of $B_{km} = B_{mk}$: One textbook (*1*) distinguishes B^{ρ} and B^{I}, which refer, respectively, to the energy density ρ and intensity I; $B^I = B^{\rho}/c$. In the original Einstein paper (*2*) only the B^{ρ} coefficient is used. My grid implicitly identifies B with B^I.

2. Use of $(4\pi\varepsilon_o)$: Ortí and Planelles prefer to include explicitly this factor $(4\pi\varepsilon_o)$ in the expressions relating μ^2 to A and B and to the integrated absorption coefficient, $\int \varepsilon\, d\omega$. An example in the text of my paper recognized the need for the factor; Ortí and Planelles have made the factor part of their grid.

Most disquieting, though, is my awareness of an inconsistency in my paper. My examples are dimensionally consistent with my definitions of terms. Some relations in the grid are, however, inconsistent with ones that would be derived from relations used in my examples. Let me be specific. In my example in the text, I use relations

$$\frac{f}{\int \varepsilon\, d\omega} = \frac{(4\pi\varepsilon_o)c^2 m_e \ln 10}{\pi q^2 N_0}$$

and

$$\frac{B}{\int \varepsilon\, d\omega} = \frac{\ln 10}{h\omega N_o}$$

The ratio of these expressions would be

	A	B	$\int \varepsilon\, d\omega$	f	μ^2
A	1	$\frac{B}{A} = \frac{1}{8\pi h\omega^3}$	$\frac{\int \varepsilon\, d\omega}{A} = \frac{N_o}{8\pi c\omega^2 \ln 10}$	$\frac{f}{A} = \frac{(4\pi\varepsilon_o)mc}{8\pi^2 e^2\omega^2}$	$\frac{\mu^2}{A} = \frac{(4\pi\varepsilon_o)3h}{64\pi^4\omega^3}$
B		1	$\frac{\int \varepsilon\, d\omega}{B} = \frac{N_o h\omega}{c \ln 10}$	$\frac{f}{B} = \frac{(4\pi\varepsilon_o)mch\omega}{\pi e^2}$	$\frac{\mu^2}{B} = \frac{(4\pi\varepsilon_o)3h^2}{8\pi^3}$
$\int \varepsilon\, d\omega$			1	$\frac{f}{\int \varepsilon\, d\omega} = \frac{(4\pi\varepsilon_o)mc^2 \ln 10}{\pi e^2 N_o}$	$\frac{\mu^2}{\int \varepsilon\, d\omega} = \frac{(4\pi\varepsilon_o)3hc \ln 10}{8\pi^3\omega N_o}$
f				1	$\frac{\mu^2}{f} = \frac{3he^2}{8\pi^2 mc\omega}$
μ^2					1

$\omega = 1/\lambda$ (m^{-1}), where λ is the wavelength of the transition.
$A \equiv A_{mk}$ (s^{-1}) is the first-order rate coefficient for spontaneous emission betwen states m and k.
$B \equiv B_{mk} = B_{km}$ ($J^{-1}\, m^3\, s^{-2}$) is the rate coefficient for stimulated transition.
ε ($mol^{-1}\, m^2$) is the extinction coefficient defined from the Lambert–Beer law $I = I_o\, 10^{-\varepsilon\eta z}$. Here η (mol m^{-3}) represents concentration and z (m) path length. The natural form of the Beer law is $I = I_o\, e^{-\alpha\eta z}$. Thus, α is related to ε by the expression $\alpha = \varepsilon \ln 10$.
f (dimensionless) is the oscillator strength.
$\mu \equiv \mu_{km}$ (C m) is the transition dipole moment.
h (J s) is the Planck constant.
N_o (mol^{-1}) is Avogadro's number.
c (m s^{-1}) is the speed of light.
e (C) is the electron charge.
m (kg) is the electron mass.
$(4\pi\varepsilon_o)$ ($J^{-1}\, C^2\, m^{-1}$) is the rational factor of the SI unit sytem.