

ISSN 1471-7166

Number 4

June 2002



Reviewed in this issue...

11 software packages

5 web sites

8 books



Physical Sciences Educational Reviews



LTSN Physical Sciences

*...supporting learning and teaching in
chemistry, physics and astronomy*

Department of Chemistry
University of Hull
Hull
HU6 7RX

Phone: 01482 465418/465453

Fax: 01482 466410

Email: ltsn-psc@hull.ac.uk

Web: www.physsci.ltsn.ac.uk

The journal of the LTSN Physical Sciences Subject Centre

Physical Sciences Educational Reviews



Physical Sciences Educational Reviews is the journal of the LTSN Physical Sciences Subject Centre. It is issued twice yearly in Spring and Autumn.

The journal is free of charge to academics in UK higher education institutions. The material is also published electronically on our web site. Subscriptions are available for those outside the UKHE sector who wish to receive the paper version. Contact the Centre for details.

Items for review and offers to contribute to the review process are welcomed. Please contact the Centre.

LTSN Physical Sciences is part of the Learning and Teaching Support Network (<http://www.ltsn.ac.uk>) and is funded by the Higher Education Funding Councils of England and Wales, the Scottish Higher Education Funding Council, the Department for Higher and Further Education, Training and Employment of Northern Ireland and is supported by the Universities of Hull, Liverpool, Surrey and Leeds.

Editor

Roger Gladwin
LTSN Physical Sciences
Chemistry Department
Liverpool University
Liverpool L69 7ZD
Tel: 0151 794 3576
Fax: 0151 794 3586
Email: rgladwin@liv.ac.uk

Editorial

Welcome to this the fourth issue of Physical Sciences Educational Reviews, the journal of the LTSN Physical Sciences Centre. This edition has twenty-four evaluations. There is a good mix of physics and chemistry reviews plus an evaluation of a significant encyclopedia for the astronomy community.

Additionally in this edition we have details of two important events for the physical science community later this year; the **Physics Discipline Network Workshop** at Leeds (see page 22) and the **Variety in Chemistry Teaching Conference** at Keele (see page 34).

Finally there is a short article (on page 19) on the **mathematics problem** from the author (Peter Kahn) of one of the books reviewed.

Roger Gladwin
Editor

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Atoms and Molecules



Subject area

Chemistry.

Description

An introduction to the electronic structure of molecules, a discussion of the analysis of charge densities in molecules, and software to download for the analysis of charge densities.

Authors

R.F.W. Bader, McMaster University.

Last updated

no data.

Level

Undergraduate (level 1).

Plugins required

None.

Other features used

None.

Reviewed using

PC, 600MHz Pentium III, 128 MB RAM over a LAN.

Web address

<http://www.chemistry.mcmaster.ca/faculty/bader/aim>

Tony Harker
Department of Physics and
Astronomy
University College London
Gower Street
London
WC1E 6BT
April 2002

There are three main components to this site, clearly specified on the home page (<http://www.chemistry.mcmaster.ca/faculty/bader/aim>). One is an introduction to the electronic structure of molecules, the second is a discussion of the analysis of charge densities in molecules, and the final one allows the reader to download software for the analysis of charge densities. The material is written by a leading authority, and is factually totally reliable. The site is densely packed with information: there is at least one long book's-worth here.

The electronic structure of molecules is treated comprehensively, starting from an introduction to quantum mechanical ideas (historical) and moving through the particle in a box to the hydrogen atom and on to molecules. The author chooses to deal only with real wave functions: this is helpful when it comes to visualizing charge densities, and it is convenient to think of three p-orbitals directed along the Cartesian axes. This requires some sleight of hand when it comes to discussing magnetic moments, but this is quite well done. The descriptions of the formation and energetics of chemical bonds are particularly well done, with plenty of useful diagrams. The diagrams are fairly basic, but this does mean that the response of the site is rapid. This area of the site is well worth a visit.

The part of the site that deals with atoms in molecules presents the author's own scheme, based on topological considerations, for dividing the molecular charge density into atoms and bonds. This is interesting background material for the student, but it may give the impression that there is one and only one way of allocating charge densities to atomic sites within atoms: in fact, different partitions may be useful for determining dipole moments, polarisabilities, intermolecular potentials, and so on. The software which is available from the third part of the site implements this 'atoms-in-molecules' approach. It is not really for the beginner, though, as it requires access to a suitable quantum mechanical code to provide the charge densities.

The units used in the site are a little dated: cgs units are used for mechanical quantities, esu for electrostatics. Among the minor points that jarred is the fact that the uncertainty principle is quoted as an equality rather than an inequality.

The treatment is kept deliberately non-mathematical, to the extent that Schrodinger's equation is not written down. Nevertheless, there are enough formulae to produce the problems common to web sites with a significant mathematical content, quantities in equations often do not match in font the same quantities in the text, subscripted and superscripted quantities float wildly about the baseline of the text, and bit-mapped representations of formulae look unpleasant.

Overall, the site resembles an uploaded book or set of lecture notes rather than something designed from the outset as a web site. It does not take much advantage of the possibilities that web-based documents offer. Hyperlinks are very sparsely used: they are present only in the sense that they are in a conventional printed document, to refer to specific equations or figures (in the latter case they are often redundant, as the figure is visible at the same time as the link). The page layout includes a header in which all the chapters are

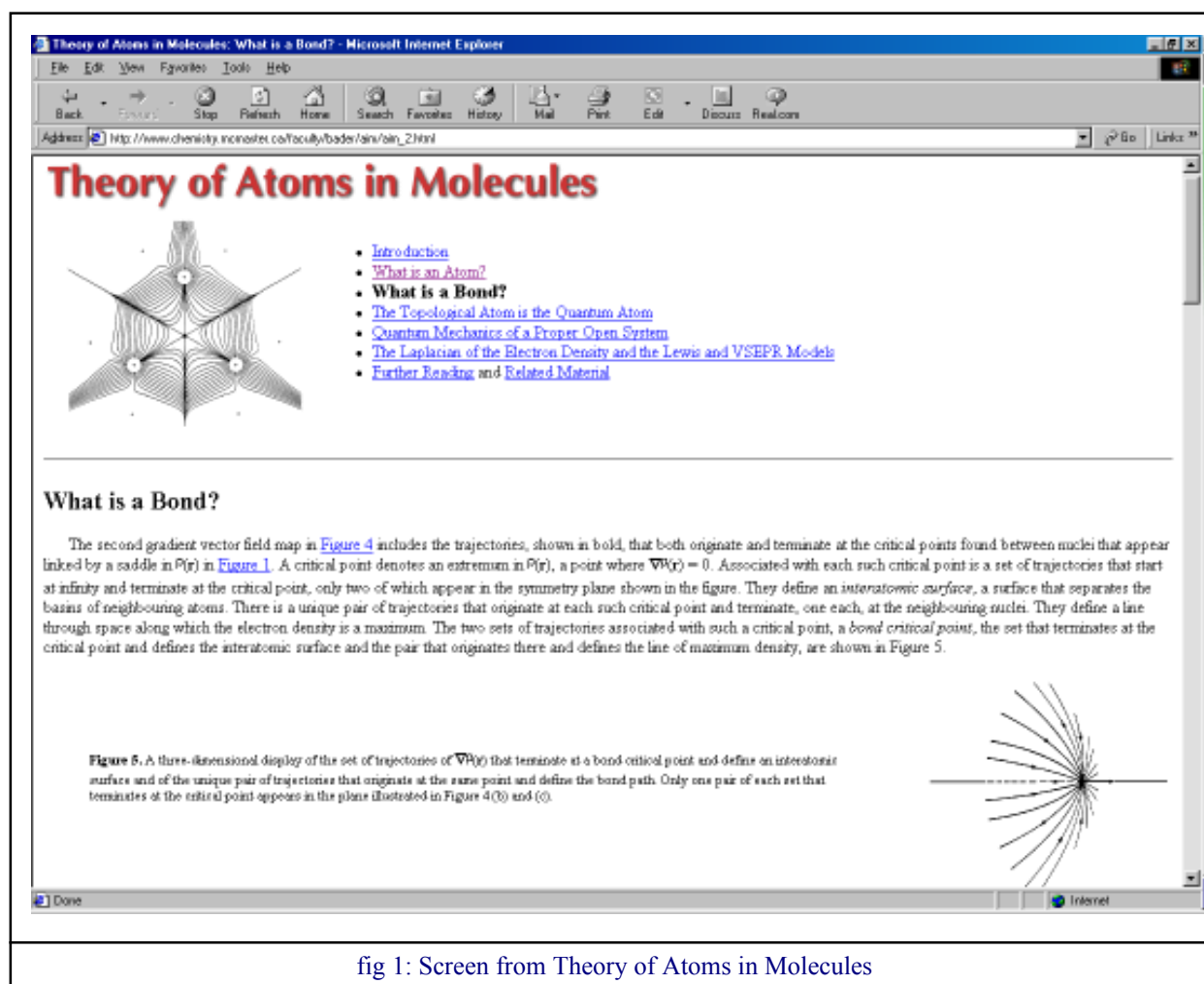
Summary Review

range: * very poor to ***** excellent

Ease of navigation	***
Speed of response	****
Ease of learning	***
Content	****
Relevance	****
Accuracy	****
Usefulness to student	***
Usefulness to teacher	***

Continued on page 3

Atoms and Molecules



Theory of Atoms in Molecules

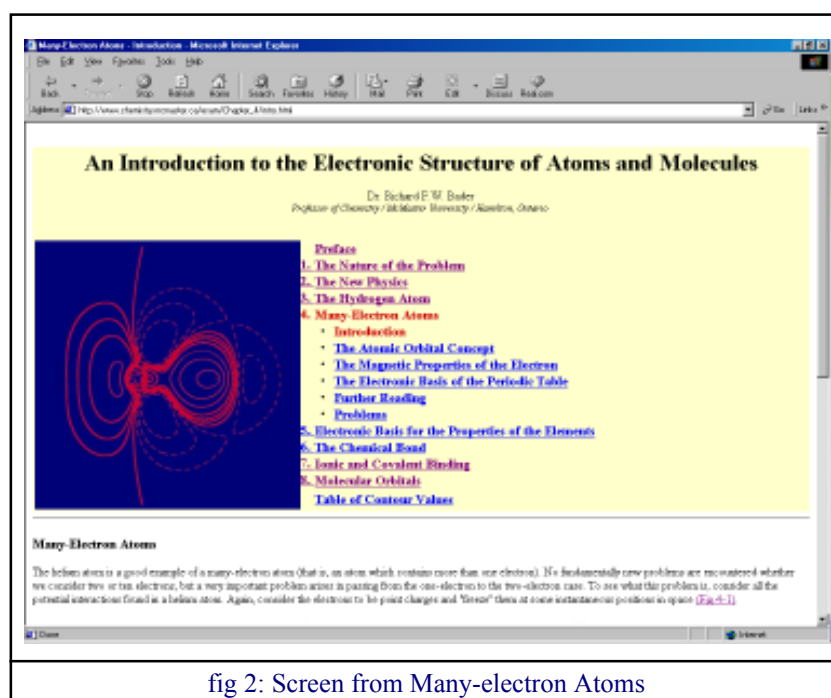
- [Introduction](#)
- [What is an Atom?](#)
- [What is a Bond?](#)
- [The Topological Atom is the Quantum Atom](#)
- [Quantum Mechanics of a Proper Open System](#)
- [The Laplacian of the Electron Density and the Lewis and VSEPR Models](#)
- [Further Reading](#) and [Related Material](#)

What is a Bond?

The second gradient vector field map in [Figure 4](#) includes the trajectories, shown in bold, that both originate and terminate at the critical points found between nuclei that appear linked by a saddle in $\rho(r)$ in [Figure 1](#). A critical point denotes an extremum in $\rho(r)$, a point where $\nabla\rho(r) = 0$. Associated with each such critical point is a set of trajectories that start at infinity and terminate at the critical point, only two of which appear in the symmetry plane shown in the figure. They define an *interatomic surface*, a surface that separates the basins of neighbouring atoms. There is a unique pair of trajectories that originate at each such critical point and terminate, one each, at the neighbouring nuclei. They define a line through space along which the electron density is a maximum. The two sets of trajectories associated with such a critical point, a *bond critical point*, the set that terminates at the critical point and defines the interatomic surface and the pair that originates there and defines the line of maximum density, are shown in [Figure 5](#).

Figure 5. A three-dimensional display of the set of trajectories of $\nabla\rho(r)$ that terminate at a bond critical point and define an interatomic surface and of the unique pair of trajectories that originate at the same point and define the bond path. Only one pair of each set that terminates at the critical point appears in the plane illustrated in [Figure 4](#) (C) and (D).

fig 1: Screen from Theory of Atoms in Molecules



An Introduction to the Electronic Structure of Atoms and Molecules

Dr. Richard E.W. Baker
Professor of Chemistry / All-Metro University / Altonara, Ontario

- [Preface](#)
- [1. The Nature of the Problem](#)
- [2. The New Physics](#)
- [3. The Hydrogen Atom](#)
- [4. Many-Electron Atoms](#)
 - [Introduction](#)
 - [The Atomic Orbital Concept](#)
 - [The Magnetic Properties of the Electron](#)
 - [The Electronic Basis of the Periodic Table](#)
 - [Further Reading](#)
 - [Problems](#)
- [5. Electronic Basis for the Properties of the Elements](#)
- [6. The Chemical Bond](#)
- [7. Ionic and Covalent Bonding](#)
- [8. Molecular Orbitals](#)
- [Table of Contents Values](#)

Many-Electron Atoms

The helium atom is a good example of a many-electron atom (that is, an atom which contains more than one electron). It is historically new problems are: reconsider whether we consider two or two electrons, but a very important problem arises in passing from the one-electron to the two-electron case. To see what this problem is, consider all the potential interactions fixed in a helium atom. Again, consider the electrons to be point charges and "freeze" them at some instantaneous positions in space ([Eq.\(4.1\)](#)).

fig 2: Screen from Many-electron Atoms

Continued from page 2

listed, with the one currently open highlighted. As the chapter is read, the header expands to show the sub-headings of that chapter. This often means that the screen is full of the header material and one has to scroll to see the content: if the content is, as in some sections, only a line or two long this can be irksome.

On the whole, I would feel more comfortable reading the contents of this site in book form. Nevertheless, I can happily recommend the treatment of bonding in molecules as background material to any first course in molecular structure for chemistry, physics or materials science undergraduates.

Curly Arrows: Writing Organic Reaction Mechanisms



Subject area

Organic chemistry.

Description

An introduction to writing organic chemistry mechanisms.

Authors

S.K. Armstrong, G.P. Black, I. Finlayson, J. Fisher, D. Sims, and M.R. Masson.

Last updated

1999/version 2.1.

Level

Undergraduate.

Plugins required

None.

Other features used

Java.

Reviewed using

Internet Explorer 5.5 on a PC running Windows 98 (the Java applets were not designed to run on a Macintosh).

Web address

<http://www.abdn.ac.uk/curly-arrows/>

Jonathan Goodman
Department of Chemistry
Lensfield Road
Cambridge CB2 1EW
September 2001

This set of WWW pages and Java applets provides a wonderful introduction to writing mechanisms. I began by going through the 'Getting Started' pages, which outlined the aims of the resource. It is intended to be used alongside a lecture course, and to help to provide the practice which is required to be able to make use of this key skill in understanding organic chemistry. Further pages then provided a clear introduction to the use of curly arrows, and lead on to notes on example reactions.

Summary Review

range: * very poor to ***** excellent

Ease of navigation	*****
Speed of response	****
Ease of learning	****
Content	*****
Relevance	*****
Accuracy	*****
Usefulness to student	*****
Usefulness to teacher	*****

So far, the resource provides a well presented description of an important topic, but it does not do anything which many books on organic chemistry can also do. However, now I had read the introductory pages, I could go on to investigate the Java applets, which provide facilities that no book on organic chemistry could possibly do. So far, I had used Netscape 4.73 and Internet Explorer 5 on a Macintosh to access the pages. At this point, I had to switch over to a PC, as the Java applets were not designed to run on a Macintosh. Internet Explorer 5.5 on a PC running Windows 98 worked very well.

Without reading the instructions I went straight to the first exercise. A picture of hydrogen bromide appeared, and a series of radio buttons marked with a lone pair, a partial positive charge and a partial negative charge. I quickly was able to highlight the parts of the molecule which had partial positive and partial negative charges, and pressed the "Done" button. I was told I should have marked the lone pairs too, so, suitably chastened, I returned to the instructions, which explained all of this. I now went through a series of ten molecules, marking all the lone pairs, partial positive and partial negative charges. I had a few minor differences of opinion with the program, about whether the hydrogens of formaldehyde had partial positive charges or not, and whether the methyl group of a methyl ester had a partial positive charge. In the first case, I was corrected, and in the second the program refused to let me put a partial charge where I thought one should go. The corrections were very clear and helpfully presented. Eventually I scored 94%! Exercise two was harder, but now I had worked out what sort of answers the program wanted. I went up to 96%, and I would like to have a discussion with the authors about the missing 4%! Exercise three was designed to be harder still, presenting more complex systems with more complicated mixtures of functionality.


This exercise would be very valuable for students. Beginners have an interactive way of exploring the electronic effects displayed by a series of increasingly complicated molecules. More advanced students may take the opportunity to argue with their teachers and with each other over minutiae of the program's assignments.


I then moved on to the curly arrows section, after reading the instructions. The diagrams showed a reaction, and I used the mouse to draw in the curly arrows. When I got this correct, a series of helpful notes on the reaction appeared. If I dragged the arrow to an incorrect position, then some helpful text appeared explaining my mistake, or else it told me that it had not been dragged to a defined area.

I found the curly arrows more interesting than assigning partial charges, perhaps because the conventions used were closer to those I am used to using. The text explaining the reaction and providing background information, once

Continued on page 5

Curly Arrows: Writing Organic Reaction Mechanisms


UNIVERSITY OF ABERDEEN
Department of Chemistry



Drawing Curly Arrows

Curly arrows are a special notation used by organic chemists to indicate the movement of electrons when bonds are made, broken, or moved.

Bond Breaking
The arrow in this diagram indicates that the pair of electrons that form the A-B bond are leaving A and becoming the exclusive property of B. Fragment A becomes positively charged because it is losing an electron, and B becomes negatively charged because it gains an electron.

$$A-B \rightarrow A^+ + B^-$$

Bond Making
In this second diagram, the arrow indicates that an electron pair that was the exclusive property of B is now shared in the bond formed between A and B.

$$A^+ + :B^- \rightarrow A-B$$

Note the following points

- The base of the arrow begins at the original location of the pair of electrons
- The head of the arrow points to the destination of the electrons
- The arrow always starts at a region of relatively high electron density and ends at a region of lower electron density, or on an atom with a strong affinity for electrons.

fig 1: Instructions to users for the Curly Arrows application

Continued from page 4

the curly arrows had been drawn correctly, was well thought out and very helpful. Students learning to use curly arrows may stare at structures wondering where to start. This program enables them to experiment, to find the answer, and then to build on from their first curly arrow. A student learning on their own may not get as far as the first arrow. A student being watched by a teacher may feel under some pressure to perform. This program removes the pressure, but maintains the positive feedback of confirming success and advising after errors, and so provides a new learning environment which is accessible at the student's convenience.

Java and the internet are shown to be a very powerful set of tools for this approach to teaching. However, the technology by itself would be useless without a well chosen and carefully explained set of examples. The team which produced this program is to be congratulated both on providing a good software basis for developing a course on curly arrows, and also for thinking through the information and examples which will be helpful for this. It would be useful to allow for some customisation so that slightly different conventions can be accommodated, but it could also be argued that exposure to competing ways of drawing reactions is a useful experience.

This resource is a very valuable teaching tool which deserves to be widely used. Students can proceed at their own pace, getting helpful feedback, and repeating the exercises as often as possible. I will certainly be encouraging my first and second year undergraduates to use it.

A resource as good as this immediately stimulates new ideas about how it could be developed. Could the students be marked automatically? Could they be timed? Could new reactions be entered to illustrate a particular course? It is a mark of the excellence of these web pages that they excite so many ideas about the possibilities that the technology opens up.

There is no doubt that this package does more than any textbook on curly arrows could hope to do. Computer-aided teaching is likely to be influential in the development of chemistry courses, and this is an example of computer-aided teaching at its best. Everyone who teaches organic reaction mechanisms should look at this web site, and evaluate how much it could help their students. Everyone who is learning about organic reaction mechanisms could benefit from experimenting with these examples.

General Chemistry



Subject area

General chemistry.

Description

Lecture slides and videos for multimedia course in chemistry.

Authors

The Squires Group.

Last updated

No data.

Level

Undergraduate.

Plugins required

QuickTime.

Other features used

None.

Reviewed using

Dell 550 MHz, 128 MB memory,
Netware v 3.11, Win 98 (SE), IE 5.5.

Web address

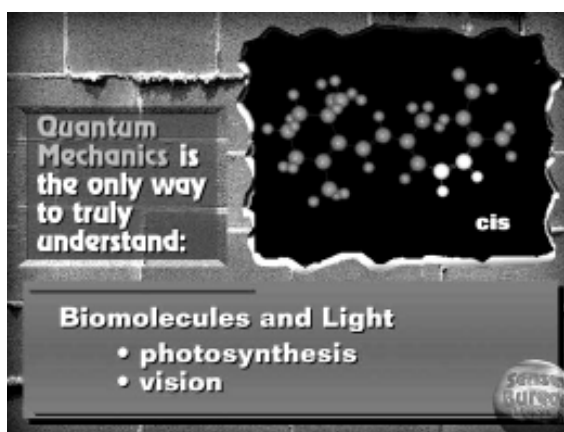
<http://www-wilson.ucsd.edu/education/> which re-directs to <http://squier.ucsd.edu/education/>

This site consists of multimedia slides and videos used in a course in Chemistry at the University of California in 1994. It comprises two sections on Physical Chemistry and General Chemistry, the first of which was reviewed in 1999 ("Welcome to the World of Physical Chemistry", item no 79 in Web Reviews). There is no evidence for any modifications or additions since that review. The material can be obtained on CD-ROM if you have a SGI machine. The topics covered are "Basics of Quantum Mechanics, Atomic Orbitals, Molecular Orbitals, States of Matter, Equilibrium and Entropy". The information is presented on graphical slides similar to a PowerPoint production and is more a summary or *aide-memoire* rather than an in-depth presentation. The authors see the site as a resource for other tutors to use in their lectures. When originally conceived and produced, the graphics would be state of the art, but now the use of 3D, shadowing and highlighting seems routine. An example is shown below...

Summary Review

range: * very poor to ***** excellent

Ease of navigation	****
Speed of response	****
Ease of learning	****
Content	**
Relevance	***
Accuracy	****
Usefulness to student	*
Usefulness to teacher	**



Ease of Navigation

Each topic is presented as a series of sections starting from an introduction and increasing in depth as you progress through. Each page has a set of thumbnails of the images and videos (QuickTime) which link to the pictures. The average size of each image is about 90 KB and video footage ranges from 0.1 - 4 MB. These could take an appreciable time to download, particularly for someone using a modem. Most of the videos are accompanied by music which might be to your taste or not, in either case I can see no relevance to the chemistry. The slides are often repetitious and some are simply stills from the accompanying video file(s).

Quality of Information

To my mind these slides contain little of value to a modern Chemistry course in the UK. Perhaps, in 1994, they would have an impact simply because of their quality, but not today. There is little substantive information and they merely serve as a pleasant accompaniment to a lecture. They provide very little that could be used in independent learning. They are easy to understand.

Steve Walker
Department of Chemistry
Liverpool University
Liverpool
L69 7ZD
May 2002

Steve Marsden's Chemistry Home Page



Subject area

Chemistry.

Description

Chemistry resources including a lecture program.

Authors

Steve Marsden.

Last updated

No data.

Level

A-level, access, undergraduate.

Plugins required

Acrobat, Chime, Shockwave. Latest version of Quicktime or Real Player, Windows Media Player.

Other features used

None.

Reviewed using

PC Fujitsu Siemens 1GHz, 128MB RAM, Windows 98, Internet Explorer v6.

Web address

<http://www.hwscience.com/smarsden/index.html>

Ron Cole

School of Applied Medical Sciences
and Sports Studies
University of Ulster
Jordanstown
Newtownabbey
Co. Antrim BT37 0QB
April 2002

As the title says Steve Marsden's Home Page is a resource and as I started browsing through it I began to ask myself where will I start, what should be the main theme of the review. A quick look tells you it is packed with useful information and resources. When you enter the WEB site the front page provides you with all the information that will be needed to navigate the site and includes the information that is relevant only to Harvard-Westlake students. When you start working through the navigation bar you open up a

very large number of resources that can lead you to further resources that again contain links. With all resources within the WEB site and its links I would be surprised if there is not something to interest everyone.

WWW links: By following this route you enter further links to related areas of study; i.e.

WWW Chemistry Links

"If you can't find what you're looking for here, you might try these other collections of chemistry-related links."

Chemistry Software and Multimedia

"These are just a few of the many things out there that I have found useful in the classroom."

These and many others provide a wealth of information that can be followed further.

Elements: This is an interactive Periodic table providing a background to the elements.

Lectures: This will be considered in detail as it is the major part of the WEB site.

Honors: This gives the course structure for Harvard-Westlake students.

AP: This introduces resources that are required by Harvard-Westlake students but could provide useful information for those searching for WEB resources.

TI/CBL: More useful links to a range of useful programs. i.e. Chemistry Lab Data Acquisition Suite, a number of programs which assist with data gathering and processing

Media: Links to the required Plugins for the main teaching program and further links to related programs.

Topics: To quote from Steve Marsden: "There is a lot of good stuff out there for chemistry students (for example, the items listed on the *Courses* page), but it can be intimidating and often difficult to wade through if you are looking for only one topic. The idea here is to use my standard course outline, unit-by-unit, and select just the links that go with the material. Two *supplementary topic areas* are provided for those that have the luxury of time to study (or teach) them."

The supplementary topics are organic Chemistry and Co-ordination Chemistry.

You could spend hours following the links to interesting and very useful sites before starting on the central core of the lecture program provided by the WEB site. The site is therefore a very useful resource for both student and teacher. The core of the site is however the lecture program.

Summary Review

range: * very poor to ***** excellent

Ease of navigation	*****
Speed of response	****
Ease of learning	****
Content	*****
Relevance	*****
Accuracy	****
Usefulness to student	*****
Usefulness to teacher	*****

Continued on page 8

Steve Marsden's Chemistry Home Page

Continued from page 7

The Lectures

Before starting on the lecture program there is a section that gives information on the system requirements and explains why certain resources are only available to Harvard-Westlake students.

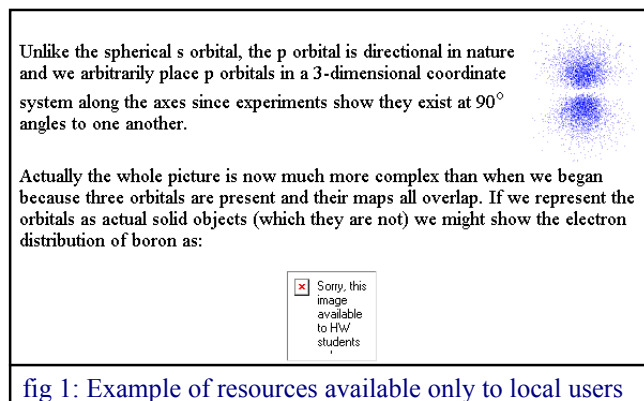


fig 1: Example of resources available only to local users

You should therefore not be surprised when you see a page similar to that shown below (fig 1), telling you an image is not available. This is a limitation to the use of the lecture programs by a non- Harvard-Westlake students but does not invalidate its usefulness. The lecture program together with its associated practical classes and tutorial/ lectures provides one year's study of chemistry by considering:

- Introduction to chemical compounds.
- Introduction to chemical reactions.
- Introduction to chemical arithmetic: mass and solution stoichiometry.
- The structure behind chemical behaviour.
- The driving forces behind chemical change.
- The structure of molecules and the condensed states of matter.
- Gases.
- The behavior of mixtures: solutions.
- Chemical kinetics.
- Chemical equilibrium.
- Nuclear processes.
- Acid/Base Equilibria.
- Electrochemistry.

(A full teaching schedule is provided via the Honors link)

Each page has a similar layout with many of them requiring a range of Plugins for which download links are supplied if required. I was using a new PC and so had to download a number of the Plugins and found that some of them were not compatible with Netscape 6 but were compatible with Internet Explorer.

The overall presentation of the WEB pages

The main navigation buttons were the same on all pages so you do not know if you have completed a topic until you try the NEXT or LAST button and nothing happens but

you soon realize this and go to the HOME button to continue to the topic of your choice. The overall presentation of the pages is clear providing a suitable amount of information. Some streamed video clips were slow to load but the majority of the downloads that were available worked smoothly. There were very few errors of any type.

All the topics were clearly structured and well presented with a range of additional material that was accessed via the navigation buttons at the side of the page. Some of the additional material would be essential, but was not available to non- Harvard-Westlake students and therefore additional support material would be required if the lectures were to be used as the main teaching resource.

Shown below (fig 2) is an example of the additional interactive resources that are available. This particular one allows you to study the effects of temperature and pressure while considering the gas laws and was typical of the interesting and instructive material provided.

Conclusion

Steve Marsden's Home Page contains a great deal of very useful information even if you would not consider using the lecture program as a teaching resource.

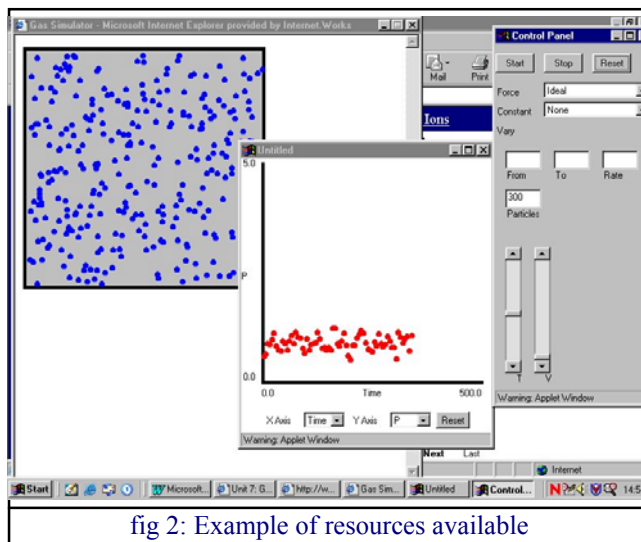


fig 2: Example of resources available

The lecture program is well structured and well presented with very few errors. They are part of the chemistry program at Harvard-Westlake School and with planning could be used elsewhere, in full or in part even, in the absence of the copyright material.

You may not use the lecture program but Steve Marsden's Home Page will be a very useful "Bookmark" on any computer used by a chemistry student or teacher.

Water Structure and Behaviour



Subject area

Chemistry.

Description

A comprehensive discussion of water, its structure and its behaviour.

Authors

Martin Chaplin.

Last updated

11th April 2002.

Level

Access, undergraduate.

Plugins required

Chime, Hyperchem Chemical Objects for the Web.

Other features used

Java, Javascript, frames.

Reviewed using

500MHz PC with 128MB RAM, LAN, Windows 98, Navigator 4.7.

Web address

<http://www.sbu.ac.uk/water/index.html>

Roger Gladwin
LTSN Physical Sciences
Liverpool University
Liverpool
L69 7ZD
May 2002

This web site is a presentation of water, its structural theories and an explanation of the complex behaviour of water. It is suitable for a higher education chemistry-based course (or any scientifically minded individual) but was I assume written originally for Food Scientists as that is the author's background. The site is extensive and it would require several hours of activity to cover all the material. However, the structure of the site is such that there are manageable 'chunks' to delve into in one go.

Summary Review

range: * very poor to ***** excellent

Ease of navigation	*****
Speed of response	*****
Ease of learning	*****
Content	****
Relevance	****
Accuracy	****
Usefulness to student	****
Usefulness to teacher	****

The major content areas are:

the structure of water describing the icosahedral model with evidence, **appendices** including the anomalous behaviour of water; models, spectra, orbitals for the water molecule; hydrogen bonding; ionisation; the phase diagram of water and extensive notes and physical data related to water, **hydration** much here to do with Food Science – the Hofmeister series (the ranking of various ions toward their ability to precipitate a mixture of hen egg white proteins), kosmotropes and chaotropes (originally denoted solutes that stabilized, or destabilized respectively, proteins and membranes - later they referred to the apparently correlating property of increasing, or decreasing respectively, the structuring of water), sugar hydration, protein hydration etc, **related materials** eg Platonic solids (Plato linked earth, air, fire, water and the universe to shapes – water to an icosohedron), homeopathy, magnetic and electric effects.

There are nearly 350 references (but you need to visit the library to read them!) and links to other water-related sites (this has an annoying/fun Javascript which sets a trail of 'water molecules' after the mouse cursor on the screen), a visitor's book, site news and a search facility.

The site uses hyperlinking to good effect and navigation is no trouble. There are also extensive high quality graphics presented to aid understanding. Text fills the available width of the browser window. I personally find reading text across a whole page tiring, and there is a lot of text to read! Some pages require a browser that supports inline frames – my Netscape 4.7 did not! Links to other web sites (eg the MathCAD site for a list of definition of constants) open in a new window so you are in no doubt that you have left the 'water' site. The site is regularly and often updated and the site news link provides a log of updates undertaken by date.

To take full control of the site requires a couple of plug-ins. The Hyperchem, Chemistry Objects on the Web (COW) plug-in and the MDLI Chime plug-in are both extensively used. There are links to both the sites required to download the plug-ins should they be needed. Chime seems OK on most platforms but the COW plug-in caused problems. I could not get it to work at all on my system running Internet Explorer 5.5 (this is a known problem) and despite my system being set up with a better specification than required (need DirectX 6.1 or later and 16bit colour) I could not at first get the plug-in to work with either Netscape 4.7 or 6.2. Eventually I set the colour option down to 16bit colour (from 32bit colour) and bingo! the plug-in worked. The web site also used Java and JavaScript plus links to external applets (eg a very useful animation of water dipoles orientating in electromagnetic radiations oscillating electric field).

The site has been well received by those who have visited as evidenced by the many positive comments in the visitor's book.

Encyclopedia of Astronomy and Astrophysics



Subject area

Astronomy and Astrophysics.

Description

A reference text for astrophysics and astronomy.

Authors

Editor-in-Chief, Paul Murdin.

Publishers/Suppliers

IoP Publishing Ltd and Nature Publishing Group
(<http://www.ency-astro.com>).

Date/Edition

2001.

ISBN

0-333-75088-8.

Level

A-level, access, undergraduate, research.

Price

£450 + £130 per year for web site.

Hugh Jones
Astrophysics Research Institute
Twelve Quays House
Birkenhead CH41 1LD
February 2002

This encyclopedia provides a reference text with no rival in astrophysics and astronomy. It runs to four solidly bound volumes and over 3600 pages. The index alone consists of 76 pages, each with three columns of fine-type listings. The format follows traditional alphabetical ordering and high quality binding and paper. The encyclopedia's sturdiness allowed it to arrive safely despite a protracted journey. The large volumes open flat for easy photocopying. An associated web site www.ency-astro.com is intended to keep its content up to date.

Summary Review

range: * very poor to ***** excellent

Academic content	*****
Usefulness to student	****
Usefulness to teacher	*****
Meets objectives	*****
Accuracy	*****

The Encyclopedia is designed for students and professionals. Each article is intended to span its subject matter at a range of levels which get progressively more specialised the deeper you get into the article. There are nearly 700 main articles from subject specialists. Each is a self-contained account of a particular topic. Each article is intended to be self-standing and ends with a bibliography pointing to the additional sources including web references. In addition to these main articles there are smaller articles and entries for definitions of astronomical terms, descriptions of individual objects, biographies of distinguished astronomers and astrophysicists, main space vehicles and missions as well as descriptions of the larger terrestrial observatories and astronomical institutes throughout the world.



Its editorial team and advisory board comprise of a large number of distinguished and experienced astronomers and astrophysicists and it does not take long to realise that the encyclopedia is an authoritative, well written and well informed piece of work. It is not hard to say that this is a very valuable addition to a library. Every department should have access to it. With its extensive entries and essays on such a broad range of topics, the browsability of these volumes makes them of interest to a very wide variety of audiences. Many students will find it exciting to be able to access such subject depth in a non-textbook format.

In general the authors in charge of the various sections are real experts on the subject. The text is generally up-to-date and the references at the end of each entry are very useful. In some cases there is detailed information enabling one to work immediately on the subject area, e.g., the solar interior section. In other cases the material is much more descriptive, e.g., red giant stars section. There is some duplication with the entry on cataclysmic variables and there was a whole section on nova Cyg 1992 which could have been a subsection of novae or CVs. There are other novae that could have been selected to have their own entries if this was intended to illustrate the observational characteristics of the class. In general the editors seem to have accepted the entries at face value rather than vigorously refereeing them which means that some of them are arguably not as well-rounded as a more traditional review publication. For example Fred Hoyle's biography does not mention his prediction of the resonance that permits the Be-8 isotope to exist for sufficient time to allow for the addition of a third particle to form carbon. This resonance was found soon after in laboratory experiments and solved the problem of nucleosynthesis.

Continued on page 11

Encyclopedia of Astronomy and Astrophysics

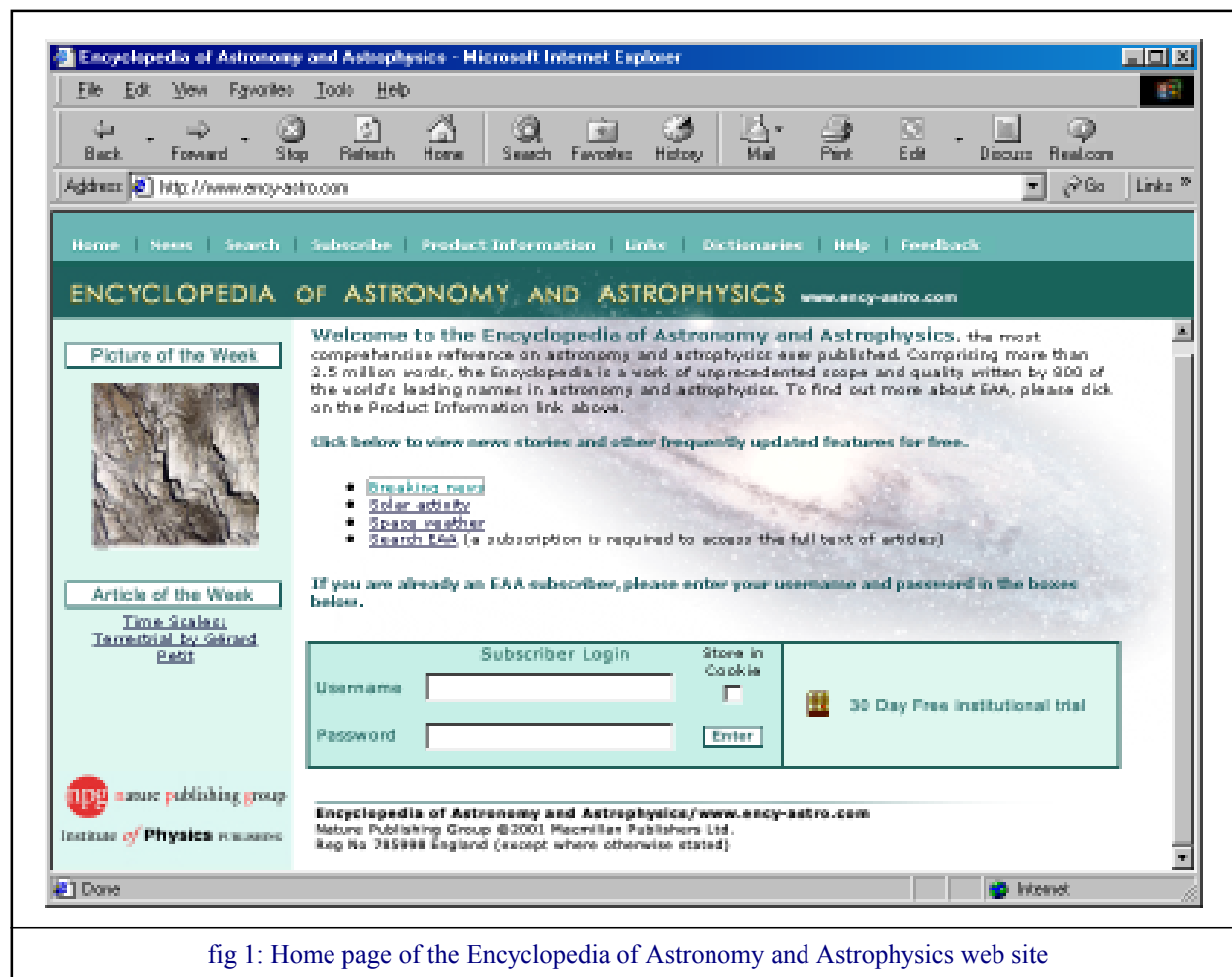


fig 1: Home page of the Encyclopedia of Astronomy and Astrophysics web site

Continued from page 10

A significant problem that students will find with the encyclopedia is that the level of presentation is quite inhomogenous. This is inevitable given the hundreds of authors and their individual interpretation of the most appropriate level of presentation. So although the encyclopedia is an excellent tool for lecturers it may not be so suitable for students in the early years of a degree which is not primarily astrophysics. This arises because to cover one branch of astrophysics one must jump to dozens of different entries written by different authors at very different levels of complexity. Although some material is at the level of a basic undergraduate text much is closer to Annual Reviews in Astronomy and Astrophysics. A PhD student commented 'A good reference but there are times when you need to know what is being said before you can understand it'. It is thus pleasing to see entries on basic physics (e.g., blackbody radiation) although these are understandably brief and this information is best derived elsewhere. Some statistics is included, for example, Malmquist bias has a major entry - again potentially very useful but unbalanced compared to some of the physics entries. From a student point of view more such entries should be included although then it would get even larger. Nonetheless students of all levels should find it fun to browse.

Updates will be the key to the long-term success of the encyclopedia. The Online version did not work well using Netscape 4.75 running on a linux operating system, although it is improving all the time. It is possible to setup workgroups which would be a useful way of making material available to a class group, however, the inconvenience of having to use passwords might lead many educators to post an article to a local site. Despite minor shortcomings the encyclopedia represents a fantastic student resource, however, the pricetag is also fantastic. Whilst main university libraries will be obliged to buy it whatever the pricetag, 200 pounds or so might be the limit for departmental or large public libraries where often such reference texts may see maximum use. Hopefully the demand for this encyclopedia will allow a larger print run and a reduced price.

Fundamentals of Physics



Subject area

General physics.

Description

A general, comprehensive physics text.

Authors

David Halliday, Robert Resnick and Jearl Walker.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2000/Extended Sixth Edition.

ISBN

0-471-33234-8.

Level

Access, undergraduate.

Price

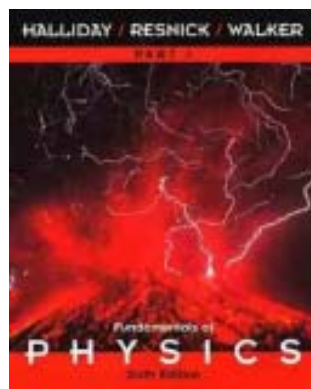
£22.50 (www.Amazon.co.uk).

Note: see review of CDROM version on page 25 of this journal

Dominic Dickson
Department of Physics
Liverpool University
Liverpool L69 3BX
February 2002

In the Physics Department of Liverpool University we have been using this textbook for Year 1 for well over 10 years. The decision to move to a single compendium-type text of this type, designed for the American system, accepted that it was aimed at a slightly lower level than the range of texts on particular topics that we were using at the time of the changeover (e.g. Kip for Electricity and Magnetism, Kleppner and Kolenkov for Mechanics, etc.). However it was felt that to recommend a single text would ensure that the students would actually purchase it and more importantly that a slightly lower level of coverage coupled with a higher level of student's mastery would be a good outcome. In addition to the difference in level the topics covered in HRW have a somewhat different balance than those traditionally covered in Year 1 of a Physics degree in an English or Welsh University.

All the American University (i.e. with calculus) Physics texts have almost identical coverage and can be considered as clones of HRW. Therefore if adopting a text of this type it is necessary to either accept the material as covered or add and subtract to a lesser or greater degree to produce the required coverage. In particular we have a module on Physics of Materials (essentially Properties of Matter in the style of the book by Flowers and Mendoza) which has a content which is mostly not covered in HRW.



Fundamentals of Physics is in my view a very well presented book from the pedagogical point of view. Diligent students could in principle teach themselves using this book and its various supplements. In fact the supplements constitute a very comprehensive ancillary package developed to help both teachers teach and students learn. One of the problems I have found is that to fully investigate all the ancillary material would be an extremely time consuming task. In my experience there is little evidence either of students or colleagues making extensive use of this ancillary material.

A related issue is that the material covered in HRW is also covered in a large number of very similar textbooks which can be essentially regarded as clones of each other. Although it is likely that some of these may be somewhat better than HRW in some respects they are all very similar. In Liverpool we have considered from time to time whether we should change from HRW to another equivalent (e.g. Serway, Sears and Zemansky etc.) sometimes following the urgings of publishers sales representatives. However the work involved in making a comprehensive comparative analysis, involving all the teaching staff involved in Year 1 Modules, has precluded any changes from what is essentially a very satisfactory textbook. An appropriate comparison might be between a Ford Mondeo and other equivalent cars on the market (e.g. Vauxhall Vectra, Peugeot 406, etc. etc.). Unfortunately there is not yet a Year 1 Physics textbook to compare with the Jaguar X-Type (made in Liverpool!).

In my opinion and those of my colleagues HRW represents an entirely appropriate, well presented and well supported text that serves the needs of our students. The level is just about right to build on their pre-university preparation in Physics embodied in the current AS and A2 curricula.

Summary Review

range: * very poor to ***** excellent

Academic content	*****
Usefulness to student	*****
Usefulness to teacher	*****
Meets objectives	*****
Accuracy	*****

Matter and Interactions: I - Modern Mechanics; II - Electric & Magnetic Interactions



Subject area

Physics.

Description

Intended for an introductory college physics course (USA) as might be taken by science and engineering students. Equivalent to a level spanning the British GCE A2/1st year undergraduate classes in these subjects.

Authors

Ruth W. Chabay and Bruce A. Sherwood.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2002/1st edition.

ISBN

0-471-35491-0/0-471-44255-0.

Level

A-level, access, undergraduate.

Price

£27.50 each (www.Amazon.co.uk).

Philip Bradfield
School of Computing & I.T.
University of Wolverhampton
Wolverhampton
WV1 1EQ
April 2002

These two volumes present a somewhat “up-beat” treatment of the foundations of physical science, at a level which might be useful as collateral reading for U.K. and other English-speaking students of Physics at GCE A2 and (especially) 1st year undergraduate levels.

They were developed as part of a worthy initiative at Carnegie Mellon University, and reflect their U.S.A. origin in some of the language and style.

The diagrams are mostly computer-produced, and regrettably have strayed into the area of “false realism”: simple line diagrams are usually enough, and somewhat grotesquely faceless “manikins” are not really helpful: science is after all about abstraction and “appropriate sufficiency”.

Some of the diagrams and associated text are less than helpful, indeed some are confusing e.g. Fig. 3.15, and some fall below the standard we might expect at this level: e.g. origins of axes not shown explicitly, and identical labelling of non-equivalent cases in related diagrams. In some cases, insufficient care has been taken: e.g. Fig. 4.29, showing possible orbital trajectories from a planet, does not show the crucial focal role of the planet’s centre for all categories of trajectory.

The language, although reflecting much modern imaginative and sophisticated thinking, is sometimes too expansive without always being sufficiently precise: what might be appropriate as dialogue in a face-to-face teaching situation usually needs to be pared down and refined if it is to be committed to the page for repeated and wide-spread reading. Text should kick-start and enthuse the reader’s imagination, intellect and understanding, not swamp (exhaust ?) with over-lengthy explanations. Something has to be left for the reader to “chew on”, and cases worthy of extensive treatment are probably best left to (guided) exercises, of which there are plenty.

There is an implicit link to some specific software, but this reviewer has not explored that aspect, not least because OpenGL is called for, though not explicitly mentioned in the text.

The volumes attempt to present a complete coverage, including some quantum mechanics and special relativity, at this level, and as such for most courses it will be an “all or nothing” choice. Where the scheme is fully supported it would have every prospect of success, but there is perhaps a significant danger in depending too heavily on one source at any level: the capacity of students to read widely and from different styles of writing is surely worth promoting. However, many in the U.K. have successfully used either “Nelkon and Parker” or “Muncaster” (or equivalent) one volume sources for A-level Physics courses, but then had to read more widely in undergraduate years.

The volumes are to be recommended and would be very useful and thought-provoking additions to teachers’ and lecturers’ personal, and institutions’ library, book-shelves - but with their U.S.A. origin they are unlikely to be adopted as course-books within the U.K..

Summary Review

range: * very poor to ***** excellent

Academic content	***
Usefulness to student	***
Usefulness to teacher	****
Meets objectives	****
Accuracy	***

Nuclear Physics, Principles and Applications



Subject area

Nuclear physics.

Description

This book is intended for science and engineering students, who require basic knowledge in nuclear physics concepts and applications.

Authors

John Lilley.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2001.

ISBN

0-471-97935-X.

Level

Access, undergraduate.

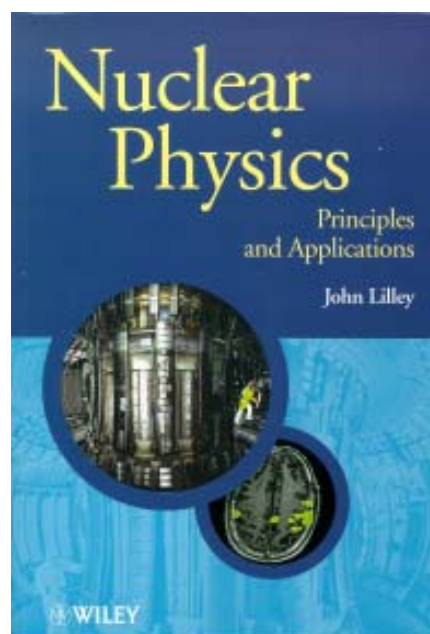
Price

£75.51 (www.Amazon.co.uk).

This book is the most recent addition to the very successful and widely-used "Manchester Physics Series", a series of textbooks for physics at first degree level. It aims at science and engineering students, who require basic knowledge in nuclear physics concepts and applications.

The book is subdivided into two parts. The first part (4 chapters, about one third of the text) is a brief introduction to the basic concepts of nuclear physics.

The second and more extended part of the book (7 chapters) deals with a wide variety of nuclear physics instrumentation and applications. These comprise interaction of radiation with matter, detectors and accelerators, biological effects of radiation, industrial applications, nuclear medicine, and nuclear power generation.



Summary Review

range: * very poor to ***** excellent

Academic content	****
Usefulness to student	*****
Usefulness to teacher	*****
Meets objectives	****
Accuracy	****

Each chapter is concluded with a set of 10-20 well-posed problems.

The book is complemented with a valuable collection of appendices of constants, key derivations, hints and solutions to the problems, short bibliography, index, and, most useful, a table of nuclear properties for more than 1000 nuclides.

The first part, the general introduction to the basic concepts, gives a brief but fair account of Nuclear Physics, especially those of importance for technical applications. This part compares well with many existing textbooks on this subject, but does not stand out. While adequate for engineering students, the level of detail is perhaps not always sufficient for physics students. For instance, the book does

not mention parity violation in beta decay, an aspect of nuclear physics one certainly would like to bring to the attention of physics students.

It is clearly the second part of the book that is distinctive and makes it a very useful addition to the reading list for each Undergraduate Course on Nuclear Physics. The variety of applications presented here demonstrates that nuclear physics is still a lively, relevant and very interesting part of physics. The level of detail gives a very good understanding for the power and limitations of the individual techniques.

In summary, "Nuclear Physics, Principles and Applications" by John Lilley is a good synthesis of the basic physical concepts and their applications and is well suited for use in, or for enhancement of, undergraduate teaching. I certainly will use it in future.

Johannes Knapp
Department of Physics and Astronomy
University of Leeds
Leeds LS2 9JT
April 2002

Organic Reaction Mechanisms



Subject area

Organic chemistry.

Description

A workbook to lead students through the process of deducing organic reaction mechanisms.

Authors

William C. Groutas.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2000.

ISBN

0-471-28251-0.

Level

Undergraduate.

Price

£27.50.

Matthew D. Fletcher
Department of Chemistry
University of Wales, Bangor
Bangor
Gwynedd
LL57 2UW
May 2002

This book isn't quite what I was expecting from the title, however the sub-title "Selected Problems and Solutions" reveals its purpose. Thus Groutas has provided not a thorough treatise on organic reaction mechanisms to compete with Peter Sykes' "A Guidebook to Mechanism in Organic Chemistry", but what is best regarded as a workbook to lead students through the process of deducing

organic reaction mechanisms. Groutas' stated goal is "to use organic reaction mechanisms as a means of facilitating the mastery and understanding of the fundamental principles of organic chemistry, while at the same time sharpening a student's reasoning ability and critical thinking." In my view Groutas has achieved this goal: an undergraduate working through this book would indeed gain significant expertise in deducing organic reaction mechanisms, a command of curly arrows, and a good grasp of the underlying principles of organic chemistry. The book is aimed at students taking a sophomore-level organic chemistry course (Part A) and first year graduate organic chemistry courses (Part B) and the author has road tested the problems in such courses (he is based at Wichita State University, USA); in the UK context Part A would be appropriate for first year undergraduate chemists to study alongside their principle textbook and lecture notes, and Parts B and C for more advanced undergraduate courses or in postgraduate problem classes.

The book contains 210 problems (with solutions) all bar one or two in the format, "Write a mechanism for the following reaction:" followed by a scheme showing reactant(s), reagent(s) and product(s). The vast majority of the problems are taken from the primary literature, with references provided at the back of the book. The schemes and equations are drawn clearly though they do look like somewhat old fashioned in style (probably because they are set in Courier) but this is merely a minor distraction. Similarly the solutions are clearly presented as curly arrow mechanisms, with accompanying notes where necessary, in a section following the questions (so there is no danger of seeing them "by mistake") and are commendably thorough, with proton shuttling steps being shown in full. The schemes and solutions, and the book in general, contain few significant errors, though I found myself in disagreement with three of the mechanisms presented as solutions. I consider that some of the solutions have insufficient accompanying notes, i.e. to explain why one product results rather than an alternative, e.g. 5 vs. 6-membered rings or double bond positional isomers.

As the book is a workbook it is appropriate to comment on the contents in order. The book begins with useful and easy to follow notes on writing reaction mechanisms. These notes (and the subsequent minireviews) are interspersed with a few exercises for which solutions are not provided and which are simpler than the 210 problems. The book is wedded to the Lewis acid / base approach to analysing and solving the mechanistic problems, with mention of nucleophiles and electrophiles only coming later. Hence there are no radical or pericyclic reactions in the book. The introductory notes (and the minireviews) will be useful to students because they put into words much of the subconscious background thinking to the process of writing mechanisms employed by experienced organic chemists, however one "trick of the trade" not mentioned is the numbering of carbon atoms to facilitate mapping atoms between reactants and products, a technique that would aid the solution of the more taxing problems (especially those in Part B). A set of 10 worked examples follows the notes, these are well chosen to illustrate general principles, provide guidelines and highlight exceptions to those principles and guidelines.

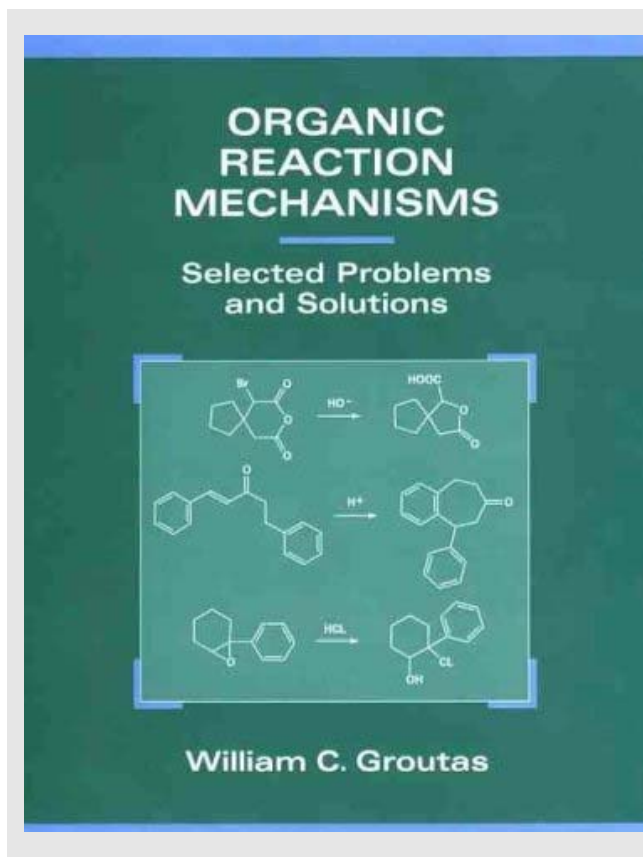
Summary Review

range: * very poor to ***** excellent

Academic content	***
Usefulness to student	****
Usefulness to teacher	***
Meets objectives	*****
Accuracy	****

Continued on page 16

Organic Reaction Mechanisms



From the publisher...

Organic Reaction Mechanisms: Selected Problems and Solutions

William C. Groutas

This hands-on manual allows readers to gain a better understanding of organic reaction mechanisms by solving a wide range of problems. Answers for the problems are included along with mini-reviews that summarize and emphasize fundamental principles. This approach sharpens readers' reasoning ability and critical thinking.
 0-471-28251-0 288pp 1999 £27.50

Continued from page 15

It is emphasised throughout that the objective is not memorisation of mechanisms but their deduction.

The first three minireviews cover Lewis structures, etc., resonance (both of which would be revision for UK first year undergraduates) and carbocation chemistry, all include worked examples. There follow the first 34 problems, which may be solved by application of the principles covered in the preceding pages. This pattern continues with Minireviews 4 – 6 covering anions, SN2 and E2 reactions and the opening of strained rings, followed by further problems. Minireview 7 and its associated problems concern nucleophilic addition to aldehydes and ketones, finally minireview 8 and its problems cover nucleophilic acyl substitution. The minireviews and their 100 associated problems constitute Part A of the book.

Part B consists of 100 notably harder problems, the extra difficulty here is partially due to the problems being encountered in isolation, rather than directly after the appropriate background material as in Part A. None of these problems are unduly obscure, and notes are included

where necessary to annotate aspects that might not feature in an undergraduate course. These problems may be solved using the methods learnt in Part A. Finally Part C consists of 10 “applied problems” (e.g. related to drug activity) of a comparable level of difficulty to those in Part B, with notes to provide the context.

Overall I regard this as a good book for the purpose it sets itself, i.e. to facilitate students' understanding of organic chemistry through the use of reaction mechanisms. I would prefer there to be greater use of the terms nucleophile and electrophile and more mention of stereochemistry and the shape of molecules, nevertheless it is a valuable source of problems with solutions, space for which in general organic textbooks is usually rather limited. I will recommend it to first year undergraduates and to our library.

Quantum Mechanics: Concepts and Applications



Subject area

Quantum mechanics.

Description

Introductory text book exploring quantum phenomena within a highly mathematical framework.

Authors

Nouredine Zettili.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2001.

ISBN

0-471-48944-1.

Level

Undergraduate, research.

Price

£29.95

Jonathan Goss
School of Physics
Stocker Road
Exeter University
Exeter
Devon
EX4 4QL
April 2002

Nouredine Zettili's book is a substantial and necessarily mathematical introduction to the 'concepts and applications' of quantum mechanics. The intended user is a physics undergraduate with good grounding in the relevant mathematical techniques since, despite a chapter dedicated to the 'mathematical tools of quantum mechanics', the text takes much of the mathematical background for granted. The general areas covered by the text are those found in an introductory and even parts of a more advanced quantum mechanics course, and each topic is covered from both the historical and mathematical basis.

The text covers all the important ideas underpinning quantum theory: the topics of uncertainty, probabilistic interpretation, and wave vs particle aspects are explored in some depth and clarity in the introductory chapters. Potential well and barrier types of problems are treated in one and three dimensions, and aspects of angular momentum, many-body properties, time-dependent perturbation techniques and scattering theory are also covered. Much is made of the connection of the quantum mechanical phenomena to concepts that are likely to be familiar to the reader. For example, there is a section relating the Pauli exclusion principle to the periodic table of elements. Someone constructing a course from scratch might well use this text as a foundation.

In style, Zettili's text is more verbose than some others written for the same readership, and in places appears to repeat material covered earlier in the text. The use of examples and worked problems is exemplary, and the number of exercises at the end of each chapter would be very useful for a dedicated student. A minor criticism of this book is that the graphs and diagrams are used rather more sparingly than one might wish for, although where illustrations appear they are clearly presented and appropriately placed. In general the style allows the reader to quickly cover familiar ground, and identify areas to on which to focus.

Despite the very attractive qualities of this volume, there is one key criticism of this book: the number of (presumably typographical) errors in the text. These are typically present in the mathematical expressions where a student approaching quantum mechanics for the first time is most in need of absolute precision. Many errors are of a rather easy to overlook nature, such as the apparently random omission of the "hat" symbol to indicate operators, or the use of bra and kets where inequality symbols are needed. More importantly there are also sign errors and some expressions that contain nonsensical terms. However, on balance since the density of mathematical notation in this book is rather high, the errors do not constitute a fatal flaw. I look forward to a future, corrected edition of this book.

Viewing the book as a whole, both the material covered and the quality and quantity of worked problems and exercises, I would recommend this as a core text or at the very least supplementary reading for a first quantum mechanics course in physics. There is the usual prerequisite that students first learn the appropriate level of mathematics, an unavoidable requirement for anything other than a hand-waving examination of the subject matter. For teachers and tutors the book is also an asset as a source of exercises, discussion material and supplementary worked examples.

With a cost at around 30 pounds for the paperback, this book is toward the higher end of the price range of other similarly placed quantum physics text books, and this might prove decisive in its use.

Summary Review

range: * very poor to ***** excellent

Academic content	*****
Usefulness to student	*****
Usefulness to teacher	****
Meets objectives	***
Accuracy	***

Studying Mathematics and its Applications



Subject area
Mathematics.

Description

This book is a study guide to enhance undergraduate learning skills in mathematics.

Authors

Peter Kahn.

Publishers/Suppliers

Palgrave Macmillan Ltd
(<http://www.palgrave.com>).

Date/Edition

2001/1st Edition.

ISBN

0-333-92279-4.

Level

Undergraduate.

Price

£11.99.

This book is intended for undergraduate students of mathematics and subjects involving the application of mathematics. After a brief introduction, Part One describes generic mathematical skills with chapters on: Using Examples; Thinking Visually; Coping With Symbols; Taking Ideas Apart; Thinking Logically; and Making Connections. Part Two of the book applies these skills to the three main types of tasks in undergraduate mathematics: Solving Problems; Applying Mathematics; and Constructing Proofs. Part Three deals with study skills: Studying Actively; Using Technology; and Succeeding in Assessment. There is a Bibliography and short Index.

Summary Review	
range: * very poor to ***** excellent	
Academic content	*****
Usefulness to student	*****
Usefulness to teacher	*****
Meets objectives	****
Accuracy	*****

The basic idea of the book is that the best way of learning Mathematics is to develop metacognitive and metalearning skills¹. Students should develop an approach to learning, to reflect on the process of learning and problem solving, and thus know when and how to use particular strategies in learning and problem solving. For example, Chapter Three (Thinking Visually) shows how diagrams can be used to better understand the qualitative behaviour of complicated equations and to visualise which data are significant.

I found the book to be easy to read, with good use of examples and revision exercises for each section. Some sections also have extension exercises. Answers and comments to most of the exercises are in the back of the book. Learning objectives are clearly set out at the start of each Chapter. Key ideas are highlighted in boxes. Specific examples and applications are set out in shaded boxes. The book can be read either cover-to-cover, or in sections as particular needs arise. The detailed table of contents and lists of figures and examples are most helpful in the latter case. However, I would have preferred a more extensive index.

Many students have difficulty in applying skills learnt in one academic discipline to another discipline. This is especially true of applying mathematical skills to biology, economics, chemistry, and physics². Peter Kahn has indicated where mathematical skills might also apply to these other disciplines. The application of differential equations to reaction rate laws in chemistry, population changes in biology, and dynamics in physics is mentioned. Less "obvious" examples like the use of quadratic equations in chemical equilibrium have not been included, but I concede that this omission might be deliberate to keep the book short and easy to read. Nevertheless, future editions might be improved by using "realistic" (ie non-integer) numbers in some of the examples³.

Part Three of the book, alone, would justify the cost. There is useful advice on: how to prepare for lectures and tutorials; how to benefit from both group study and individual study; how to get the most from computer algebra systems and other software packages; and how to succeed in assessment through good communication, preparation for examinations, etc. Given the many demands on students' time, how do we, as teachers, motivate students to actually read this book? In my opinion, the answer is that all secondary-school and university teachers should have a copy of this book on their shelves, and that the various metacognitive and metalearning exercises be incorporated into routine class teaching.

I recommend this book to the target readership, undergraduate students of mathematics. In addition, I recommend this book to all secondary and tertiary maths teachers.

Kieran Fergus LIM
School of Biological and Chemical
Sciences
Deakin University
Geelong, VIC 3217
Australia
April 2002

Continued on page 19

Studying Mathematics and its Applications

Continued from page 18

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2. P. New, S. Britton, M. Sharma and A. Brew, "Researching the transferability of mathematical skills", in *Proceedings of Research and Development into University Science Teaching and Learning Workshop*, ed. A. Fernandez, UniServe Science, Sydney, 2001, (<http://science.uniserve.edu.au/pubs/procs/wshop6/>).
3. Donald Wink, University of Illinois at Chicago, "Math and Chemistry. Was: Exams and calculators", *Chemistry Education Discussion List*, CHEMED-L@MAILER.UWF.EDU, 24 February 2002, (<http://mailer.uwf.edu/Lists/wa.exe?A2=ind0202&L=chemed-l&P=R38852>).

Solving the mathematics problem

We all know only too well the difficulties that students from the physical sciences face when learning mathematics. In recent years several departments have closed down at least in part as a result of these difficulties. Proposals for a new degree in physics for those with more modest mathematical experience are also an indication of the scale of the problem.

Next academic year these difficulties are only likely to become more pressing. Recent changes to A levels in the shape of Curriculum 2000 were meant to encourage more students to study mathematics. But earlier this year nearly one third of pupils failed the new AS level in mathematics.

In universities, many of the solutions that have been proposed to these problems have focused on which mathematical ideas students should learn and on providing extra tuition. However, we also need to consider the ways in which mathematical ideas are actually taught and learnt. For instance, students tend to focus on getting tasks done. Unfortunately, if a student completes a mathematical task without trying to link the ideas involved to other relevant ideas then their learning is typically only useful in the short term.

Take the task of mathematically modelling some phenomenon. Students need to do more than memorise standard models. They also need an appreciation for each stage of the modelling cycle, such as the introduction of concepts from the real world and their mathematical representation. But beyond this, these stages each involve more fundamental mathematical thought processes. Understanding a mathematical concept, for example, might involve analysing the concept so that the student can make sure they actually understand all of the contributory ideas. This kind of approach exposes connections between ideas. It is the kind of strategy recommended to students in a study guide on mathematics and its applications that Palgrave have recently published.

Lecturers need to realise they can no longer get students to make connections simply by explaining mathematical ideas and by requiring students to solve problems. This indeed is a key message in the forthcoming text on mathematics and its applications in the new Institute for Learning and Teaching series on effective learning and teaching. And students need to realise that it is more important to make connections between ideas than simply to complete tasks. Only when we apply these insights in practice will an end to the current difficulties with mathematics be in sight.

Studying mathematics and its applications by Peter Kahn was published by Palgrave in October 2001. *Effective learning and teaching in mathematics and its applications* will be published by Kogan Page in January 2002 and is co-edited by Peter Kahn and Joseph Kyle.

Dr Peter Kahn
Teaching Development Officer
Teaching and Learning Support Unit
The University of Manchester
Manchester M13 9PL

Tel: 0161 275 7473
Fax: 0161 275 2872

Understanding Physics Part 1



Subject area

General Physics.

Description

An introductory undergraduate text in classical mechanics which introduces the reader to both vector cross products and simple calculus.

Authors

Karen Cummings, Priscilla W. Laws, Edward F. Redish and Patrick J. Cooney.

Publishers/Suppliers

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Edition

2002/Preliminary Edition.

ISBN

0-471-20044-1.

Level

A-level, access, undergraduate.

Price

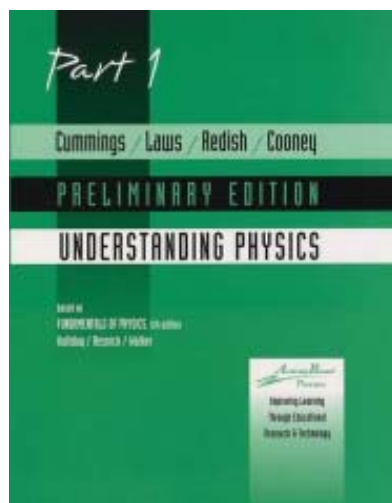
£13.16 (www.Amazon.co.uk).

Gren Ireson
Matthew Arnold Building
Loughborough University
Loughborough
Leicestershire
LE11 3TU
April 2002

This text sets out to cover the mechanics found in an introductory physics programme at a US college. The authors start by stating that this text is based on the sixth edition of 'Halliday and Resnick' which makes it a very difficult act to follow and given the changes made in the sixth edition I was left wondering why the publisher should want a competing text.

However reading through the twelve chapters of the text one soon becomes aware of the major differences:

1. The excellence of the narrative style, which is not interrupted by illustrative problems, these come at the end of the chapter under the title of 'Touchstone Examples' with more standard exercises being given at the end of the book.
2. The use of research into physics education, particularly in the area of student misconception and the use of 'reading exercises' to focus the attention of the student on key areas of each section. This, I feel, genuinely enhances the narrative and will certainly be a boost to the average or weaker student.



Summary Review

range: * very poor to ***** excellent

Academic content	*****
Usefulness to student	*****
Usefulness to teacher	*****
Meets objectives	*****
Accuracy	*****

3. The linking of the narrative to experiment procedures that all students will meet (or have met) in their study of physics. This, in my view, is made all the stronger by the manner in which the authors have integrated the use of data-logging tools for gathering, analysing and presenting data.

Overall I found this a refreshing addition to the vast number of texts dealing with mechanics at the pre-university and introductory undergraduate level. Calculus is not avoided but introduced in a non-threatening way on a 'as needed' basis. SI units are used and very clear, and consistent, vector notation is adopted. The student is taken, in very gentle steps, from basic

measurement and SI units to complicated rotations involving cross products. This approach tends to make the mechanics exciting by providing insights into everyday life or as the authors write. "Yet to find surprises in physics you don't need to wait till you study relativity or quantum mechanics."

The problems, both touchstone examples and those at the end of the book, offer something for everyone with the solutions to the former being particularly clear with 'key ideas' being highlighted.

My only complaint is with the size and quality of some of the diagrams and photographs. Even given the use of grey scale for both I feel the quality could, and given the quality of the narrative should, be improved. The size of the diagrams is obviously a matter of space but in places I did rely on knowing what should be in the diagram rather than being able to clearly read it!

In conclusion, notwithstanding the quality of the diagrams, I would certainly advise anyone looking for a fresh approach to the teaching of mechanics with the use of some basic calculus to give this book a try.

ActivStats



Subject area
Mathematics.

Description
A CDROM based course for teaching basic statistics.

Authors
Paul Velleman.

Suppliers/Distributors
Addison Wesley
(<http://www.aw.com/activstats/>).

Date/Version
1998/Version 2.0
(ISBN 0-201-31068-6).

Level
A-level, access, first-year undergraduate.

Type of package
Computer assisted learning.

Price
\$(US)50 for 2002-3 release (ISBN 0-201-78245-6) .

Hardware required
A PC 486/66MHz , 12MB RAM, CDROM, Monitor 640x480, 256 colours.

Software required
Quicktime (supplied on the CDROM).

Bill Hardcastle
LGC
Queens Road
Teddington
Middlesex
TW11 0LY
February 2001

ActivStats is a tutorial package for teaching the basics of statistics. It assumes no previous knowledge of the subject and would be suitable for self tuition as well as to supplement a more formal introductory course. Its author, Paul Velleman, is Professor of Statistics at Cornell University and the content is structured around the core material used in introductory statistics courses in the USA.

The program is designed to run under Windows 95 or NT4. Presumably Windows 98/2000 could also be used. I ran the program under NT4 direct from the CDROM but there is an option to install it on to a hard disk and full instructions are provided on how to do this both for a PC and a Macintosh. A sound card with speaker or headphones is also required as well as 'Quicktime' software (supplied) for viewing video clips. I did not have a sound card in the machine used for review and found this to be a significant limitation.

Textual information on the topics covered appears to be sparse but it is supplemented by a large number of animations - many of them interactive - accompanied by sound clips. In addition there are written 'expositions' which can be called from the menu. The lack of dense textual information appears to be a deliberate design feature and I actually quite liked the clean appearance this gave the screen. What text there is addresses itself to the essential information for the topic and expands upon this using alternate multimedia content. An 'Introduction' section describes the organisation of the package and explains how to use it. There is a comprehensive glossary and an index which enables the user to find explanations of terms very easily. A bookmark feature is also provided and this is useful for returning quickly to particular pages of interest.

The material is very much US oriented and the examples used cover a broad range of subjects though I was pleased to see a couple of examples from analytical chemistry, relating to sodium levels in hot dogs and dissolved oxygen. That said, this package is not aimed at any particular discipline.

ActivStats makes heavy use of a helper package called Data Desk which it automatically calls up when needed. This appears to be a cut down version of a stand-alone application for performing statistics calculations. Data Desk has a completely different look and feel and I found it a bit odd being dumped into this new environment to carry out some of the interactive exercises though I guess that is something I could get used to. What I could not get used to however was the lack of a sound card with which to hear the spoken content. Several times during interactive sessions I simply did not know what to do as there was no textual or visual information to guide me.

ActivStats covers the basics of elementary statistics from 'what data are' through the normal distribution, mean, standard deviation, probability, t-tests, linear regression, and the design of experiments. The discussion of t-tests promotes the use of p-values (the modern approach made possible by the computer) for evaluating results with little mention of the more traditional t-critical values. A notable omission under significance testing is any mention of the F-test. While t-tests are used for testing for significant differences between means, the F-test is used for testing whether any difference in the variances of two samples

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	****
Documentation quality	*****
Academic content	*****
Usefulness to student	*****
Usefulness to teacher	****
Portability	*****
Meets objectives	*****
Accuracy	*****

Continued on page 22

ActivStats

Continued from page 21

can be considered to be significant. I would have expected both types of test to have been covered. The two-sample t-test, which is covered in ActivStats, assumes samples of comparable variance and this assumption is traditionally tested by means of the F-test.

Overall ActivStats is a useful tool for teaching the basics of statistics. Its approach is novel and there are plenty of animations and interactive sessions for the user to test their understanding. On the minus side, without a sound

card you are severely hampered particularly during interactive sessions, as there are no on-screen prompts to guide you. Packages like this are best viewed as for personal use, since the sound output could prove distracting for others working nearby. Also, this particular package should not be relied upon to cover the full range of material that would be required by UK analytical science organisations or academic institutions.

Physics Discipline Network Workshop VIII

Widening Participation in Physics & Critical Thinking

The Physics Discipline Network was established in 1994 with initial funding from the DfEE to encourage debate and discussion of teaching and learning initiatives (and hence graduate skills) amongst university physicists. Over the past seven years we have attracted over 230 delegates from most of the UK university physics departments to one or more of our September workshops. Thank you for continuing to support our activities and we hope to make this year's Physics Discipline Network workshop just as successful.

In the morning, our keynote speaker is Prof Geoff Layer who is director of the national project, 'Action on Access' which aims to widen participation levels in higher education. At the LTSN annual conference in Birmingham in February, Prof Howard Newby made clear the Government's commitment to this activity, for which substantial future funding will be available. Dr Dominic Dickson and Dr Mark Brake will then talk about new approaches to physics courses which could widen access. A lively discussion is expected.

In the afternoon session we want to concentrate on learning techniques and we are delighted that Prof Lewis Elton has agreed to kick-start the discussion of the state of 'critical thinking' in physics teaching (despite his being in Prague on Sept 11th!). Lewis will be aided and abetted by Dr Tina Overton, who has co-authored a book on critical thinking for chemistry students. Then another double-act, involving Dr Jim Ryder and Dr Ashley Clarke, will discuss the various mapping tools, which seem to have been studied extensively at secondary school level (but little has been published about these tools at the Higher Education Level) and their LTSN-funded, developmental project to try out these maps on first year physics students.

In the final post-tea session, Dr Dick Bacon will illustrate various assessment by computer approaches and, in his inimitable way, suggest the best route forward. Rob Ward

will survey the student portfolio scene in the UK, illustrating the different ways that they are being introduced into academic departments and how they contribute to monitoring and assessment.

On Thursday evening, there will be our usual, superb meal at the University House. We have secured the services of Simon Singh (TV presenter and author of the acclaimed book 'Fermat's Last Theorem') to speak on the topic 'Science and the Media' before the dinner.

Our keynote speakers for the second day are Prof Bob Campbell and Dr Fred Lubben who have been investigating first year student's approaches to practical work. They will be followed by Dr David Milstead who is quizzical about the current standards in A-levels and Helen Reynolds will give a teacher's perspective on this debate. The meeting is an opportunity to hear the latest news about physics-related projects that have been funded by HEFCE in Summer 2002 by the Fund for the Development of Teaching & Learning (FDTL4) and whether or not they are seeking the involvement of more physics departments as partners in their projects. The Plenary Session will, as usual, look at physics student numbers expected in the delegate's physics departments and discuss potential topics for future PDN workshops.

There will be pro-active open forum sessions with plenty of time for discussion and debate.

Date/Venue 12-13th Sept 2002 at University of Leeds

Contact: Dr Ashley Clarke
Department of Physics & Astronomy
University of Leeds
Leeds LS2 9JT
e-mail: a.r.clarke@leeds.ac.uk,
tel: 0113 233 3878 **fax:** 0113 233 3900

Forces



Subject area

Physics.

Description

The package covers the fundamental definitions of force and explores the application of these concepts to a variety of physical phenomena such as the motion between objects, electrostatics, and electromagnetism.

Authors

Whistlesoft Inc. Los Alamos, New Mexico.

Suppliers/Distributors

American Institute of Physics through the Physics Academic Software (<http://webassign.net/pasnew/forces/forces.html>).

Date/Version

Mac version ISBN 1-56396-798-7
PC version ISBN 1-56396-797-9.

Level

Undergraduate.

Type of package

Computer assisted learning.

Price

\$(US)100 for single licence. High school site licence \$(US)250. 10 copy lab pack \$(US)400 .

Hardware required

A PC capable of running Windows or a Macintosh plus a CDROM drive.

Software required

Windows 3.1, Win95/98, WinNT or Macintosh system 7.0 or later.

Paul Sellin
Department of Physics
University of Surrey
Guildford
GU2 7XH
December 2001

Forces is a software package that acts as a student self-paced tutorial, exploring the physics of forces and fundamental interactions. The package covers the fundamental definitions of force and explores the application of these concepts to a variety of physical phenomena such as the motion between objects, electrostatics, and electromagnetism. It is an ambitious program in that it attempts to cover a large range of topics that spread across many parts of a typical first year British university physics course. In places, the content of Forces also extends into parts of a second year physics course, particularly in the more advanced topics on electromagnetism.

The program is marketed by the American Institute of Physics through the Physics Academic Software range, and is written by Whistlesoft Inc based in Los Alamos. In the preface to the manual, Forces is described as a 'spin-off from a much larger project, a multimedia tutorial entitled Accelerators and Beams'. If I had any criticism to make of the program, it is that it does tend to provide hypertext links to other modules of this larger project that are not supplied within the Forces package. However this is a minor point, and the overall look and feel of the software is extremely professional and user-friendly.

The Forces material is supplied on just three floppy disks, which are easily installed using the accompanying installation program. In this review I tested the software on a Celeron-based PC running Windows 98 with a modest 32 MB of memory. The authors claim to have specifically tried to keep the size of the program down to a minimum to allow the use of floppy disks, and there are no significant items of multimedia in the package. In fact, once installed the program folder contains just five short AVI video clips that are played seamlessly from within the main Forces program. The video clips do add more visual interest to an otherwise quite conventional presentation, although they are very short in length. It seems a shame that for the price of a CD more multimedia material could not have been included since there must be few users now who do not have access to a computer with a CDROM drive. It's also worth noting that, showing its North American origins, the program is available in either a Windows (Windows 3.1, Win95/98 or WinNT) or Macintosh version (system 7.0 or higher).

Once inside the program, the user is offered a basic menu of five main topics:

1. Fundamental Quantities
2. History and Tour of Forces
3. Forces and Motion
4. Electrostatic Forces
5. Electromagnetic Forces

Each topic is presented in a manner similar to a Powerpoint presentation with the normal type of navigation buttons to step-through each slide. Hypertext links are embedded within the slides that jump the user out of the current topic and into new regions of the program. These jumps caused me to lose my way through a topic several times, and you may need to pull up the integral site map to regain your bearings. This is a common effect with hypertext-based presentations in that it requires a lot of will power to stay within the topic of study and not to be side-tracked into peripheral pages.

Summary Review

range: * very poor to ***** excellent

Ease of use	*****
Ease of learning	****
Documentation quality	*****
Academic content	****
Usefulness to student	****
Usefulness to teacher	***
Portability	****
Meets objectives	****
Accuracy	*****

Continued on page 24

Forces

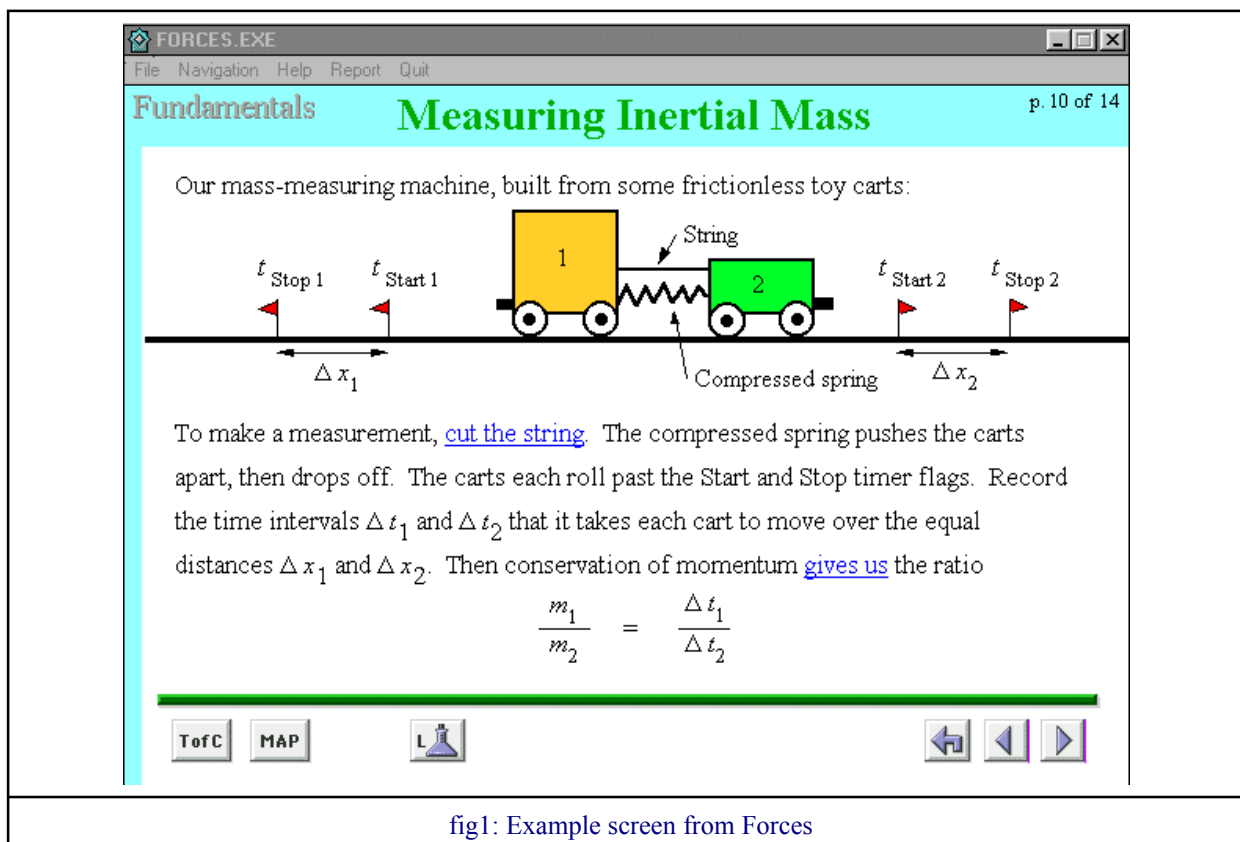


fig1: Example screen from Forces

Continued from page 23

The first topic on Fundamental Quantities provides a fairly light overview of a range of physical quantities and units. The topic covers such basic material as time, length, mass, velocity, acceleration and force. Deceptively easy discussions of length and time quickly move onto vector quantities where a vector notation is used rigorously throughout. Some nice animations are included in this topic, such as two trolleys being timed as they are pushed apart by a compressed spring (see fig 1). Unfortunately none of the animations actually generate quantitative data outputs, for example that a student could cut and paste into a spreadsheet for further analysis.

The second topic forms a brief historical tour of four great scientists from Galileo to Cavendish. Rather ambitiously, this topic also attempts a brief overview of the strong, electromagnetic, weak and gravitational forces in just four slides. The obligatory falling apple drops across the screen when gravity is discussed.

Now to the real content of the package, the three remaining topics covering Forces and Motion, Electrostatics, and Electromagnetism. Important preliminary material is covered in the areas of conservation of momentum, kinetic and potential energy, and work done, and these are applied to the specific examples of circular motion due to centripetal acceleration, and gravity acting through the inverse square law. Electrostatics is covered in six slides by discussions of the Coulomb force, electric fields, and conductors. Electromagnetism is the final topic, covering good solid undergraduate “elec and mag” subjects such as

the Lorentz force, and B-fields interacting with currents and moving wires.

Overall the Forces program provides an excellent overview to an essential section of the physics curriculum. The content of the program is dominated by topics on electricity and magnetism which can often be perceived by undergraduates as a dry topic. This self-paced overview to the subject could be useful to support student learning in this area but would need to be used in parallel with a more traditional intensive delivery of the material through lectures. Like all self-paced learning packages, it is very easy to skip through the topics at speed and only acquire a superficial understanding of the material. Clearly the authors of this package are sensitive to this problem and have pitched the level of the program about right – neither too heavy on equations nor too light with excessive distractions. It’s worth pointing out however that apart from a brief mention of the strong force in the preliminary topic, this program is very much based around electrostatic and electromagnetism. It would have been good to see a discussion of the strong force developed through the use of some radioactive decay or simple particle physics examples.

In summary therefore Forces is an impressive and well designed package, that achieves its objectives of being a self-paced interactive tutorial. Concentrating mainly on examples in electromagnetism, this program would be well-suited to provide additional support material to complement a traditional University lecture course.

Fundamentals of Physics CD - PHYSICS



Subject area

General Physics.

Description

A multimedia edition of the book by the same authors.

Authors

David Halliday, Robert Resnick and Jearl Walker.

Suppliers/Distributors

John Wiley & Sons, Inc. John Wiley and Sons, Ltd. (www.wiley.co.uk).

Date/Version

2001/6th Edition
(ISBN 0-471-37818-6)

Level

Undergraduate.

Type of package

Computer assisted learning.

Price

\$(US)79.95.

Hardware required

Pentium 166 or higher, 32 MB RAM, 4x CDROM, 800x600 screen resolution.

Software required

Netscape Communicator V4.7 or Internet Explorer V5.0 or higher, Shockwave Player V5.0 or higher.

Note: see review of book on page 12 of this journal

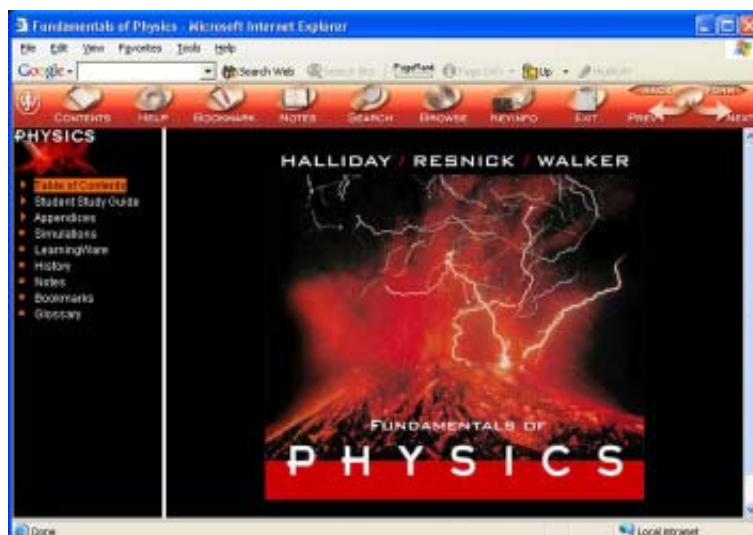
John M. Williams
Department of Physics and
Astronomy
University of Sheffield
SHEFFIELD
S3 7RH
April 2002

This software package is based on the best selling textbook *Fundamentals of Physics (6th Edition)* by David Halliday, Robert Resnick and Jearl Walker. It contains the complete text (Chapters 1-45) as well as the student solution manual, study guide, animated illustrations and Interactive LearnWare. It is very easy to install and is a most comprehensive aid to studying basic physics. As with all sophisticated software it takes a little time to get the best from it but it is intuitive in its approach and when mastered yields lots of very useful aids to learning.

Summary Review

range: * very poor to ***** excellent

Ease of use	*****
Ease of learning	*****
Documentation quality	*****
Academic content	*****
Usefulness to student	*****
Usefulness to teacher	*****
Portability	*****
Meets objectives	*****
Accuracy	*****



The user friendly graphical interface (see Main Menu Bar) is well designed and allows users easy access to a range of powerful study aids. Included is a "Bookmark" facility and "Notes" in which students can write their own comments to be printed later. At the top right hand of the Menu Bar are two sets of navigation buttons. The top pair are the usual "history" back and forward buttons, whilst the lower pair allow users to see the previous and next topics from within the text. Useful appendices cover SI units, fundamental constants, astronomical data, conversion factors, mathematical formulae, properties of the elements and a periodic table.

Each chapter is accompanied by a video clip in which one of the authors presents a "puzzler", the answer to which may be found in that section. The "Student Study Guide" provides a tutorial and review of each chapter plus advice on problem solving within each topic.

A particularly useful component of the CD is the inclusion of some 75 interactive physics simulations.

These consist of both simulations (see fig 1: "Interference of Light example") in which the student may vary the relevant parameters (e.g. wavelength, slit width, slit separation, etc.) and immediately see the effects, and what are referred to as "Active Figures".

Continued on page 26

Fundamentals of Physics CD - PHYSICS

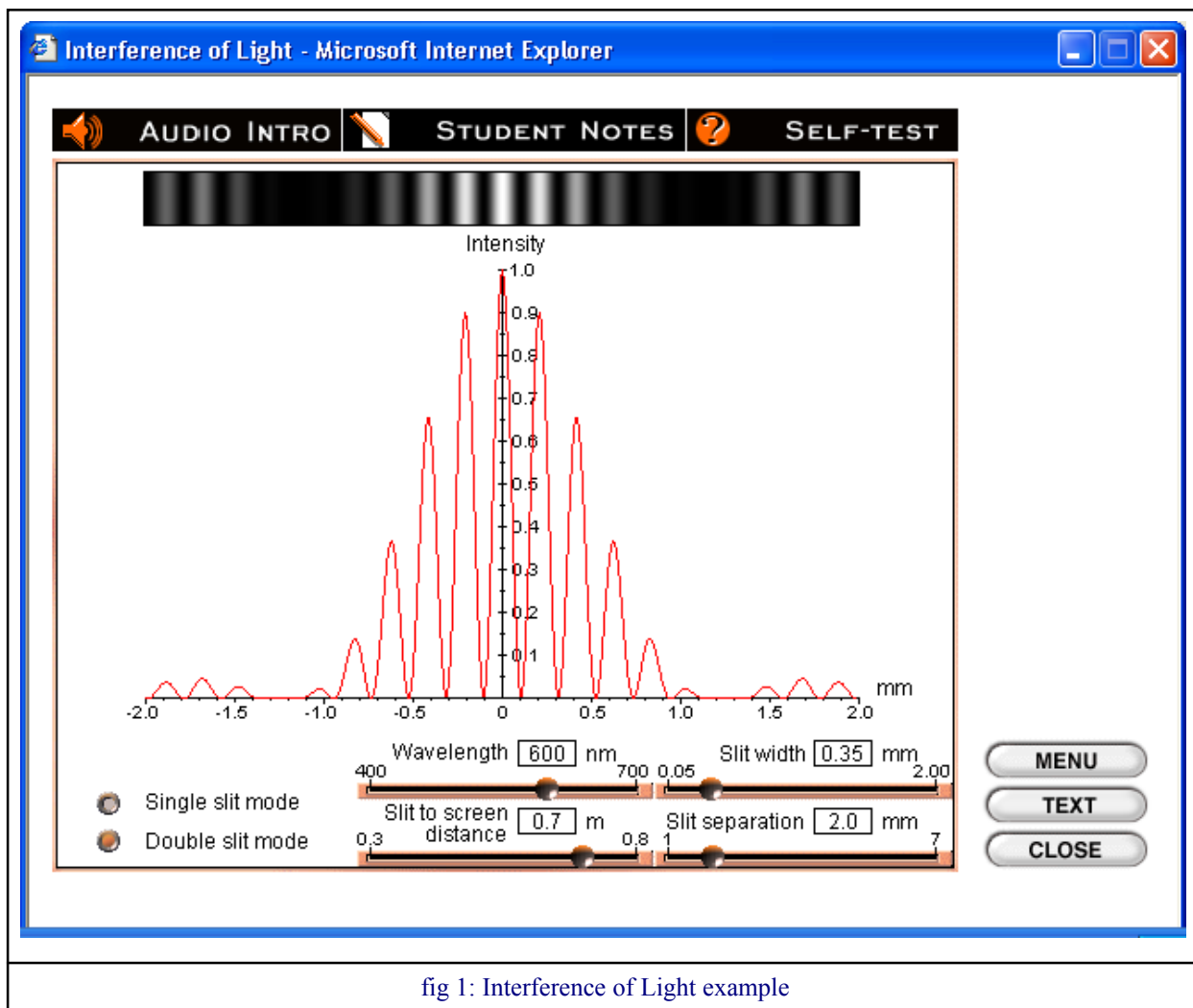


fig 1: Interference of Light example

Continued from page 25

The latter are animated versions of figures which appear in the text. These animated figures provide the student with a further insight into the physics and are valuable educational tools which greatly enhance the product.

The LearnWare section addresses problem solving and leads the student through selected problems from within the text (typically 6 from each chapter). Students can attempt to proceed by inputting their answers to step by step questions, but if wrong get the option of trying another value or being led through the solution. This can be very useful to students working alone.

The dynamic multimedia CD approach is good and offers an intuitive graphical, browser-based interface. Needless to say there is a powerful search facility and any page, figure, chapter section, note, etc. may be printed individually.

The hardback book sells for just under £100, a price which will be a barrier for many UK students. The availability of this CD version (approx. price \$80) thus makes it a more attractive option as it includes all the text in addition to providing the additional facilities outlined here.

I found little wrong with this CD package; it is detailed, well thought out, complete and robust. My only concern is the relatively high cost which, given the enormous effort put into its production, may well be unavoidable.

Molecular Movies Version 2



Subject area

Organic Chemistry.

Description

Organic reaction mechanisms using 3D molecular movies.

Authors

ChemLibris.

Suppliers/Distributors

ChemLibris, Fatburs Brunnsgata 11, 118 28 Stockholm, Sweden (<http://www.fatburen.org/chemlibris/chemlibris>)

Date/Version

2001/version 2.

Level

A-level, undergraduate.

Type of Package

Simulation, teaching aid.

Price

\$(US)190 for classroom licence.

Hardware required

PC: Pentium processor, 32MB RAM, colour monitor, 256 colours, sound, CDROM drive.

Mac: PowerPC processor, 32MB RAM, colour monitor, 256 colours, CDROM drive.

Software required

PC: Windows 95 or later or Windows NT.

Mac: OS 7 or 8

John Leaver
10 Willow Bank Drive
Bollington
Macclesfield
Cheshire SK10 5DG
September 2001

Molecular Movies 2 is a CDROM containing information about a small range of organic reaction mechanisms. The mechanisms covered on this CD are electrophilic addition to alkenes (HCl and Br₂), electrophilic aromatic substitution, nucleophilic substitutions (unimolecular and bimolecular), eliminations (E1 and E2), nucleophilic addition to C=O and nucleophilic substitution in the context of carboxylic acid derivatives. This selection might be suitable for use with some A-level or early undergraduate curricula.

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	****
Documentation quality	**
Academic content	****
Usefulness to student	***
Usefulness to teacher	****
Portability	****
Meets objectives	****
Accuracy	****

The software is easily installed from the CDROM by running a setup program, and can subsequently be run from the Windows Start menu.

PC and Mac versions are provided. Only the PC version was tested for this review and it ran with no problem on several machines of varying specification.

The opening screen, which occupies about two thirds of the desktop, is a table of contents. The heading for each named reaction mechanism is a hypertext link to information about that mechanism. The format, and screen layout is the same for each mechanism and navigation of the screens is straightforward. So, for example, clicking the 'Nucleophilic addition' hypertext link brings up a menu of information about that reaction mechanism. This comprises an introduction, information about the substrate and nucleophile, the transition state, some examples (in this case alcohols, amines and enolates) and a 'Remember' section that highlights the salient features of the mechanism. The background information provided in the sections just mentioned also contains hypertext links from words that may need further explanation. These glossary links lead to explanations or definitions of the terms together with other useful information. For example the 'nucleophile' link leads to a definition of the term and a table indicating nucleophilicity, type and basicity for some common nucleophiles. The last item on the menu for each of the mechanisms covered is 'GO TO MOVIE'. This leads to an animation of the mechanism. The screen is laid out in a fairly obvious way with 'video' style controls to play the animation. The molecules are represented as three-dimensional ball and stick models and in addition, at the bottom left of the window is a Gibb's energy vs reaction coordinate plot. As the course of the mechanism progresses a circle moves along the curve of the energy diagram indicating, for example, when transition states are reached. It is possible to vary the playing speed. Slower speeds tend to be more useful. More useful still is the facility to step through the reaction a little at a time. This feature is particularly good when used in conjunction with a data projector, as it is possible to add one's own commentary about what is happening in the reaction. The 'movies' do have sound but this is limited to some rather irritating whistles and chimes coinciding with significant steps in the mechanism. Fortunately it is possible to adjust the sound volume to zero!

Overall this package is a useful supplement to other methods of exploring reaction mechanisms. The background information is good, although does not offer significant advantages over the same information in a book (except perhaps that some students like to look at things on screens rather than in books). The animations however do offer advantages over static representations of reaction mechanisms. If used with a data projector in 'stepwise' mode they provide an excellent way to take students through each mechanism.

Orbit Xplorer



Subject area

Physics, astronomy.

Description

Simulation package for gravitational physics experiments.

Authors

Ottisoft (<http://www.ottisoft.com>)

Suppliers/Distributors

Ottisoft (<http://www.ottisoft.com>)

Date/Version

v2.0.

Level

A-level, access, undergraduate.

Type of package

Simulation, computer assisted learning.

Price

\$(US)25 for a single user license, \$(US)89 for a site licence (both include free upgrades).

Hardware required

Pentium 200MHz or faster, 32 MB minimum RAM, 16bit colour depth or better.

Software required

Windows (95 or later).

Simon Bates
Department of Physics and
Astronomy
University of Edinburgh
Mayfield Road
Edinburgh
EH9 3JZ
March 2002

This is a first-rate, extensive piece of software that provides simulation activities to support a wide range of basic gravitational physics topics. Ready-made simulations exist for many common topics, such as Kepler's Laws, escape velocity, double stars and Lagrange points. In addition, there is plenty of scope to create other simulations with relative ease.

The package was straightforward to install as a self-extracting executable. It looks attractive, is well laid out and easy to use. The

graphical user interface will immediately feel familiar to users of Windows software. For the user who just wants to dive in and experiment with the ready-made simulations, it is rather easy to get a simulation up and running (a couple of obvious mouse clicks) and change simulation parameters etc. For those with more patience, there is a good tutorial designed to look very much like the "Windows Help" pages that tours all major features of the software. Data input pages have a context-sensitive help feature that allows specific help on a given box or field.

Visually, the simulation output is impressive, utilising real images for planetary and other objects, which makes the whole impression far more believable than watching coloured dots whizzing around a screen. Simulation graphics and derived results (eg graphs of distance, energy etc versus time) can be easily saved /copied to the clipboard and incorporated into learning materials or printed out.

All ready-made simulations come with suggested activities and background information and many have web links to further information resources. This is a real bonus; these activities can be utilised as-is or adapted for purpose.

Two of the package's great advantages over other simulation materials that might exist is that there is such a range of examples all under one roof, and all of these are customisable and extensible. There is more than enough ready-made material for most introductory (possibly even intermediate) physics courses. Different audiences can take as much or as little as they need or are able to from the simulations.

I used this package extensively over a couple of days, played with all the ready-made simulations and was unable to find major problems with the program. It never crashed, hung and there were sanity checks for when I tried (deliberately) to do something stupid. I used a fairly high-end machine to test this package; it is numerically and graphically intensive and I suspect that although the package will run on the bottom-line specification above, it will be greatly enhanced on a somewhat newer, faster machine.

I intend to use this package in two situations. In an introductory physics course, it will be invaluable for bringing concepts such as Kepler's laws and planetary motion to life. I also intend to experiment with other simulations that will be offered as small computational based-projects/experiments in later courses; gravity assists of satellites etc. The package is extremely competitively priced and compared to the only other package I have seen like it (Open Universe and now Celestia) it is easier to use and more extensible. In conclusion, this is an excellent package that I would recommend for teachers of school and university students alike.

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	*****
Documentation quality	****
Academic content	*****
Usefulness to student	****
Usefulness to teacher	*****
Portability	*****
Meets objectives	*****
Accuracy	*****

Organic Chemistry



Subject area

Organic Chemistry.

Description

CDROM based Multimedia Tutorial on Organic Chemistry.

Authors

Prof. B C Sanctuary.

Suppliers/Distributors

MCH Multimedia Inc
(<http://www.mchmultimedia.com>).

Date/Version

Version 3.10.

Level

Undergraduate.

Type of package

Computer assisted learning.

Price

\$(US)79.99. (A 50% student discount is available).

Hardware required

PC486 processor, 16MB RAM, 800x600 monitor, sound card and CDROM drive.

Software required

Windows 95.

Ron Cole
School of Applied Medical Sciences
and Sports Studies
University of Ulster
Jordanstown
Newtownabbey
Co. Antrim
BT37 0QB
January 2002

This is one of the chemistry tutorial resources on CDROM written by B.C. Sanctuary. On receipt of the CDROM I found that the installation instructions were clear and the program installed with no problems. The initial installation gives the trial (time limited) version and it is only after registration that the full version is available. The registration requires WEB access and this crashed on me a number of times leaving me locked out. An E-mail to the publishers solved the problem. After this the program ran smoothly except where links between section were used.

When I attempted to use the links an error message appeared and the program closed. This only occurred for links between topics not links within a topic.

A previous review¹ of one of the CDROMs discussed the general features of the tutorial CDROMs and this tutorial uses all the same general resources and drop down menus, all of which operated but were not totally applicable to the topics under consideration.

The program entitled Organic Chemistry not only used the same general layout and features of the series but also drew on some of the others in some cases indiscriminately, e.g. a knowledge of bonding is essential in all areas of chemistry but the discussion of ionic bonding in the gas phase did not seem to sit easily in an organic chemistry tutorial. All the major organic functional groups are considered in detail and the tutorial has a final section entitled biochemistry.

Biochemistry

This section provided a basic introduction to the structures of biomolecules with a number of RASMOL frames, which provided insight into the importance of the 3D structures of the molecules. There was however a number of simplifications and errors which make this section of limited use.

The Quick Tour

Provides an introduction to the functionality of the program and is useful although drawing its examples from areas outside of organic chemistry.

An Introduction to Organic Chemistry

Provided a quick over view with sufficient information to remind the student of the basics of each of the main sections.

After the introduction the main areas of study started with a consideration of stereochemistry.

Stereochemistry

This section provides a good introduction to the subject with a number of good illustrations and animations but has chosen an approach in a number of areas, which although completely correct is not used in any other of the text books I have access to. This is a useful section that would be difficult to use in conjunction with any other resource because of the differences of approach.

Bonding

The goals of this section are given as: To introduce the concept of bonding. Compare the diatomic bond to a spring and discuss how the energy and forces vary as the bond length changes.

Summary Review

range: * very poor to ***** excellent

Ease of use	*****
Ease of learning	*****
Documentation quality	****
Academic content	*****
Usefulness to student	*****
Usefulness to teacher	****
Portability	***
Meets objectives	*****
Accuracy	***

Continued on page 30

Organic Chemistry

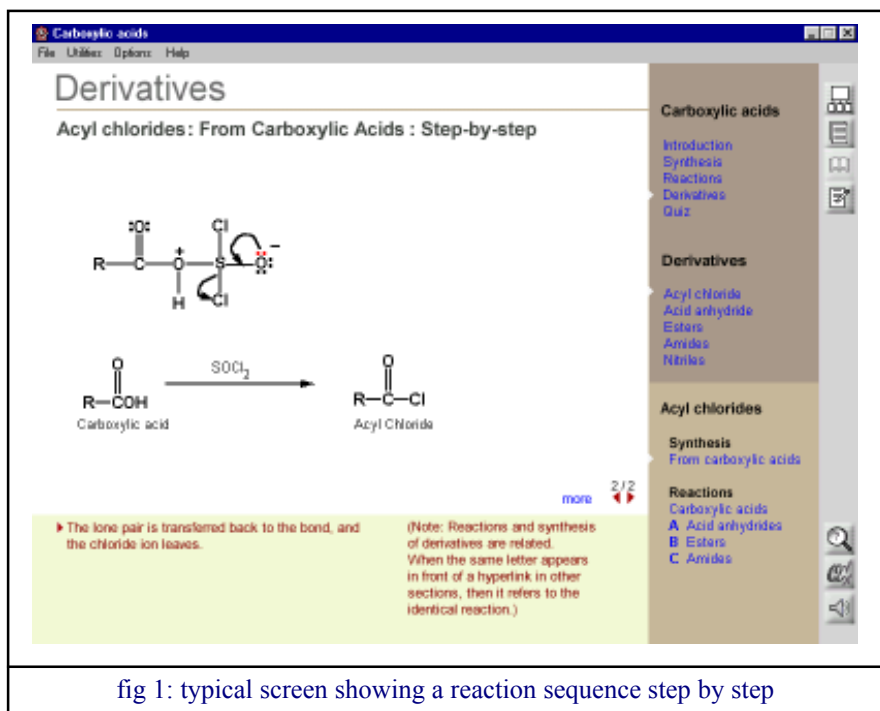


fig 1: typical screen showing a reaction sequence step by step

Continued from page 29

The goals of this section are fulfilled and all the concepts necessary for the consideration of bonding in organic molecules are well covered but as indicated in the introduction to the review there is a significant amount of material present that is not totally appropriate and leads to the conclusion that the whole section has been imported from a more general tutorial.

A more tailor made section on bonding would be more appropriate.

Acid & Bases

This section provides a general discussion of acid/ base properties. The information provided is essential but not specifically tailored to a tutorial on organic chemistry and its appropriateness must be questioned. I would have preferred to have seen a section aimed more directly at the consideration of organic acids and bases.

After the introductory sections the remainder of the program is devoted to the consideration of organic reaction types, nomenclature and functional group chemistry.

Organic Reaction Types

The aim of this section is to introduce the idea of "mechanism" so that it can be used in subsequent studies. The SN_1 , SN_2 , E_1 and E_2 mechanisms introduced very clearly it is a pity that terms such as nucleophile and electrophile are used before they are explained.

Nomenclature

This section covers all the functional groups and is only let down by requiring some large jumps in knowledge

The Functional Groups (alkenes, alcohols, ethers, aromatic compounds, aldehydes, ketones, carboxylic acids and amines):

Each functional group is discussed under the following headings:

A general introduction

This provided an interesting and informative introduction to the topic.

Preparation

On a few occasions topics were misplaced again suggesting a lack of "proof" reading.

Reactions

Each of the functional groups was fully considered and well illustrated by the use of animated

reaction sequences. I had the feeling that these had been drawn from previously authored material because the currently available scientific drawing packages could have produced superior graphics.

Quizzes

The quizzes contained a good range of questions and required a careful study of the subject if the questions were to be answered even with the helps that were provided and on some occasions knowledge from other areas of study

The Organic Chemistry tutorial provides a large amount of useful information discussed in an interesting way and illustrated with a large number of clear animations of various types.

The quizzes definitely provide a very good check on your level of knowledge and use of all topics in the program would provide a good background in organic chemistry, bonding and acid/ base chemistry.

Overall the CDROM based tutorial on organic chemistry provided a large amount of useful information that is well presented.

There were however discrepancies between the text and the voice over and errors in the text. It is my opinion that a careful "proof reading" and consideration of the supporting topics to make them more specific to the main tutorial would enhance the whole program.

Reference

1. David Ruddick, MCH Multimedia General Chemistry CDROM, *Physical Sciences Educational Reviews* 2(2), p42, November 2001

OriginPro



Subject area

General science.

Description

Origin is a general purpose data analysis and data presentation tool for scientists and engineers.

Authors

Microcal.

Suppliers/Distributors

Aston Scientific Ltd.
(<http://www.astonsci.co.uk/origin/>).

Date/Version

6.1.

Level

Undergraduate, research.

Type of Package

Data analysis.

Price

£430 ex VAT (for Version 7) plus multi-licence options.

Hardware required

Pentium 133 MHz or Higher, 64 MB RAM, 50 MB hard disk space.

Software required

Windows 95, 98, NT, 2000

Adrian Barnes
H.H. Wills Physics Laboratory
Royal Fort
Tyndall Avenue
Bristol
BS8 1TL
May 2002

Introduction

With the widespread use of Microsoft Office on the PC, Excel (the spreadsheet program that comes as part of the Office package), is often used to manipulate, analyse and produce graphical output of experimental data. However, although it contains a powerful programming language (Visual Basic for Applications) and many inbuilt scientific functions it lacks sophisticated data fitting methods as standard. The choice of graphical output is also very limited. Origin is a general purpose package specifically designed for the analysis and presentation of scientific and engineering data and overcomes many of these limitations.

It is stated that the package will run on any of the Windows 32 bit operating systems from Windows 95 to Windows NT4 or later. For this review, the installation of the software on a Pentium III 750 MHz machine running Windows 98 SE was straight forward from the supplied installation CD. The package came with a complete set of manuals including, a tutorial manual, a comprehensive User's manual and Labtalk Manual.

The typical use of the package can be considered at three levels: graph drawing and presentation, data analysis using linear and non-linear least squares fitting methods with inbuilt or user supplied functions and programming using the in built language called LabTalk.

Data presentation

On first starting the program, the user is presented with two windows: a data window consisting of two columns, X and Y, and the Project Explorer window. The Project Explorer keeps a record of all data, graphics and log files created in the application. All of the data/graphs created in an origin session are maintained as a single origin project when saved.

Superficially the data window appears similar to that of a typical spreadsheet with a series of columns and rows in the form of a grid. Data can be entered directly by typing the data into the X, Y columns. If necessary, extra columns containing for example, error values, can also be added. Alternatively the data can be read directly from files created by many other applications. This includes simple ASCII data in delimited X, Y columns through to ODBC links to databases such as Access. In addition to this it is also possible to open an Excel workbook directly with Origin. In this case all of the Excel features, including Visual Basic macros, can be used with the framework of the origin project. This is particularly useful if data is already in Excel format and you prefer to continue using typical spreadsheet operations, or if you wish to continue to use Visual Basic macros rather than Labtalk (see later) to process your data. In effect it brings the full graphical power of Origin to your Excel workbooks.

Origin has a very wide selection of built-in 2D and 3D graph types that have a large number of possible formatting options. It is possible to build and manipulate multilayered graphs, arrange multiple graphs on the same page and link multiple axes between graphs. The range of graphical options is enough to cover the majority of scientific needs. It takes a little time to become familiar with the way data is added to graphs and the way plot layers are built up.

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	***
Documentation quality	*****
Academic content	****
Usefulness to student	****
Usefulness to teacher	****
Portability	***
Meets objectives	****
Accuracy	****

Continued on page 32

OriginPro

Continued from page 31

However, with experience it becomes quite straightforward to control the output as required. To produce 3D graphs Origin uses the concept of a matrix. 3D data can be either imported directly into Origin or the data grid in a standard Origin data sheet can be converted into Origin matrix form to enable the 3D plotting options. If necessary the supplied 2D binning routines can be used to convert the data into a suitable matrix form. Control, such as orientation and perspective views, of the 3D graphical objects is achieved by simple icon driven commands on Origin's toolbar. For large data sets a speed mode is incorporated that plots a limited number of points on the screen and hence saves time. This mode can be switched off if required and it doesn't affect the final printed output.

Data Analysis

Once data has been read into the Origin data sheet it is possible to carry out a wide range of powerful data manipulation and analysis tasks. Simple mathematical operations such as adding or subtracting constants from column data or multiplying the Y values in one column by another are easily carried out. This is achieved by defining the mathematical formula in the appropriate pull-down menu. However, the real power of the package is the ability to carry out a wide range of more complex data analysis tasks. These include:

- Linear and non-linear least squares fitting. A large number of functions have already been built into the system. In addition it is very easy to add your own as required.

- A wide range of statistical analysis tools.

- Basic peak fitting routines.

- Fast Fourier transforms and associated correlation and convolution methods.

- Extrapolation and interpolation.

- Smoothing.

and many more. In short, most of the data analysis methods required by scientists and engineers can be used without the need to write special programmes. A high degree of advanced control of the data fitting procedure is possible such as fitting selected ranges, excluding certain data ranges, controlling tolerances and adding constraints. The fitted parameters along with their associated errors and

covariance matrix are output into a log file and the final fit is plotted with the original data. Overall it is very easy to carry out very advanced data analysis procedures with simple menu driven commands and without the need for any advanced programming knowledge. The manuals also include good descriptions of the algorithms used along with references to their original implementations.

Programming

Origin comes with its own programming language called Labtalk. This has close similarities to C and allows the user to write their own applications and methods within Origin. Programming using Labtalk is clearly an advanced use of Origin and I suspect that the majority of users would not normally use it. However, with it, it is possible to build your own automated data analysis tools. For example, this would be of particular use when you are reading in standardised data and wish to carry out a series of standard operations (peak plotting and fitting for example). The Labtalk programmer has access to all the analysis methods within Labtalk as well as the ability to build dialog based instructions. However, a good deal of effort is needed to gain the full benefits of this feature.

Conclusions

Any scientist or engineer who has found the data analysis and presentation capabilities of Excel limited will see the need for a package such as Origin. The graphing facilities are excellent in both the quality and control of the output as well as the large number of built-in graph types available. Through Object Linking and Embedding these graphs can also be incorporated into any other Windows OLE enabled application such as Powerpoint. In addition to graphical presentation, Origin also puts a sophisticated set of powerful data analysis tools at your finger tips. These enable non-specialists and non-programmers, as well as more experienced scientists and engineers, to analyse data in a simple, fast and straightforward manner. It is certainly a very useful, if not essential addition, to the software suite of a modern undergraduate teaching or research laboratory. Since starting this review Microcal have released version 7.

From the supplier... Now including the Peak fitting module, **OriginPro v7** is an application development environment for building custom analysis applications based on standard Origin v7. Features include Dialog Builder which greatly simplifies the process of creating sophisticated dialog boxes and wizards, MOCA, which is an MFC-based C++ library to directly access Origin data structures from external DLLS, and a color-coded LabTalk script debugger.

You can use OriginPro v7 to develop specialized applications that use sophisticated interfaces. Wizards step users through complex procedures involving input, graph interaction, and result output. User choices can be stored as a toolbar button allowing the same procedure to be easily executed later by clicking a single button.

Custom tools can directly incorporate an Origin graph. Users have full control over every graph element. Dialog Boxes, Tabbed Tools, and Wizards can be run without showing Origin, while providing the full power of Origin's data management and analysis.

Custom tools are easily programmed using LabTalk. Object method and property syntax are based on their placement in the tool for easy reading. Object properties can be set by using literal constants or other object properties.

Physics (with Calculus)



Subject area

Physics.

Description

Complete learning environment on one CDROM for introductory physics at university.

Authors

Brian Sanctuary et al.

Suppliers/Distributors

MCH Multimedia Inc, Montreal.
(<http://www.mchmultimedia.com>).

Date/Version

4.11

Level

A-level, access, first-year undergraduate.

Type of package

Computer assisted learning.

Price

Single license \$(US)79.99. (Student license - 50% discount).

Hardware required

PC486, PowerPC based Mac.

Software required

Windows 95 or later, MacOS 8.1 or later.

Bruce Sinclair
School of Physics and Astronomy
University of St Andrews
St Andrews
Fife
KY16 9SS
April 2002

This extensive package takes the form of an “electronic book” on CD covering much of the physics needed by students near the start of their university careers. The material is presented using audio, text, and a variety of pictures, animations, and simulations. The topics covered include mechanics, thermodynamics, waves and sound, electrostatics and electromagnetic theory, quantum mechanics, special relativity, and nuclear structure. I looked at various parts of this package, but not the accompanying non-calculus physics course. The partner chemistry version has been reviewed for the LTSN by J David Ruddick¹. The MCH website suggests that there now is a newer version of the package available.

The MCH Physics package installed satisfactorily from its single CD on to my portable PC running Windows 98. MCH physics wanted to take up the whole of my 800 x 600 screen. It looked smart, and there was a consistent interface through all the material I used, corresponding roughly to chapters, headings, subheadings, and “move-on to next window-full”. It had a linked structure reminiscent of web pages with frames, although it seems to have been written in Authorware. MCH physics looks at though it has been produced as a stand-alone package for learning introductory physics. Its main “competition” is then probably general physics textbooks which have an accompanying CDROM.

There is certainly a huge amount of material in the MCH package. The main development of the physics is enhanced by quiz sections, a glossary, a student notebook, internal links to the windows calculator, appendices of useful data and equations, and a periodic table. I am not aware of paper-based material being available for students to use with the package. The main authors are listed as Brian Sanctuary of McGill University, M S Krishan of IIT in Madras, and Adam Halstead.

There were some sections which I felt did a generally nice job at developing the material, for example in the introduction of electric field and flux lines, including a useful electric field calculation and visualisation tool. The mix of written text and audio could be attractive (following the material without the audio is not a sensible option, as the printed text and the audio are quite different). There is a commendably high level of student input to the activities. There are sections that might readily be offered to students as backup material for parts of a conventional lecture course, and there are numerous animations that could be usefully displayed in a lecture or tutorial. The quiz sections could be used with the material in some courses for self-assessment for students. I did not discover a mechanism for recording student achievement on these tests.

But I have to say that my personal feeling on the package was not particularly positive. There were examples of things not working as I feel they should, there were many explanations that I was not happy with, and I often found the speech stilted.

I list specific examples of things not working as I expected:- I found no way to print (or even copy) from the otherwise useful-looking student’s notepad that was integrated into the package; one content section I was working on talked about “anharmonics”, but such things were not in the glossary.

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	***
Documentation quality	no data
Academic content	**
Usefulness to student	***
Usefulness to teacher	***
Portability	***
Meets objectives	***
Accuracy	**

Continued on page 34

Physics (with Calculus)

Continued from page 33

As examples of odd explanations, I have worries about “a small area cut out from a surface and projected back to the origin is called a solid angle” and in connection with resonances in pipes that we are told that choosing the correct wavelength for resonance creates a “nice rhythm”. There is a question given to the student about water waves, “does the water move horizontally?” There are only two possible answers given, yes or no. I chose the first, given that my understanding is that the particles in water waves oscillate both up and down and along the direction of propagation. This however, was classified as incorrect “The water only moves up or down in response to the wave”. While I think I know what the authors are trying to explain, this sort of over-simplification (my opinion) causes me concern. Again, I know what the authors mean when they tell us that numbers written in forms such as 3×10^{22} “must have the same exponent” when being added together, but it kind of gives me the impression that mathematical rules forbid me putting in $3 \times 10^2 + 4 \times 10^3$ into my calculator or computer (or head) in that form.

There certainly were many useful simulations and animations that individually were potentially useful, and there were some nice illustrated explanations. If I were to be given the choice of a good (paper-based) textbook or this version of the MCH package, I would opt for the textbook. However, I should note that the other reviewers referenced on the MCH website (<http://www.mchmultimedia.com>) seem to have more positive opinions, and indeed that my opinion of the latest version would be more positive than of this one if some of the issues above have been addressed.

Reference

1. David Ruddick, MCH Multimedia General Chemistry CDROM, *Physical Sciences Educational Reviews* 2(2), p42, November 2001

Variety in Chemistry Teaching 2002

Variety in Chemistry Teaching, now in its 11th year, provides a forum for the exchange of teaching practices, and of ideas about, the learning and teaching of chemistry at degree level.

Our students need to develop an understanding of chemical principles and an ability to apply their knowledge in unfamiliar situations. We can help them by increasing the variety of teaching methods we use. Many individuals have developed interesting ways of teaching, but have had little opportunity to discuss their ideas with others. Variety in Chemistry Teaching offers that opportunity for colleagues developing their own approaches to improvements in their teaching.

Participants are strongly encouraged to offer contributions describing teaching methods that they use and find effective. All offers of contributions are welcome. Remember, an idea that seems simple and obvious to you may not have been thought of by others. Ideas, which are still embryonic but with which authors have had limited but useful experience, are also welcome; experiences and ideas can be interesting to others even if they are not fully developed. Poster presentations and displays of computer software, videos, etc are all acceptable. A limited number of short oral contributions will be given on Tuesday morning. Those offered as a parallel session or an oral contribution must be received before 30th June.

Oral Communications

Contributions of oral communications are invited. These will be 10 minute papers followed by discussion. Speakers will not be allowed to exceed their allotted time. Papers will be selected from the range of abstracts offered in order to produce an interesting and balanced programme.

Parallel Sessions

Contributions of 2 hour workshops are invited. In these workshop sessions, groups of 15-20 will participate in activities designed to enhance student learning or other activities related to teaching and learning.

Posters and Demonstrations

Display boards for posters are 6' x 3' (180 x 90cm) and can be arranged landscape or portrait format. Material must be attached to display boards with Velcro; you must supply your own Velcro. Participants wishing to present software displays or video displays must provide their own equipment. The bench space available for equipment is adequately supplied with power and poster boards.

Date/Venue 9-10th Sept 2002 at University of Keele

Contact: Dr Paul Yates

School of Chemistry and Physics,
University of Keele,
Keele ST5 5BG

email: p.c.yates@chem.keele.ac.uk

tel: 01782 583044 **fax:** 01782 712378

Questionmark Perception



Subject area

General.

Description

A suite of programs for creating secure surveys and tests for stand-alone computers, networks or the web

Authors

Questionmark.

Suppliers/Distributors

Questionmark Ltd.
(<http://www.qmark.com/>).

Date/Version

v2.5.

Level

Undergraduate, research.

Type of Package

Grading/marketing, exam preparation.

Price

Contact supplier – prices depend upon configuration.

Hardware required

Pentium 133 MHz or better, 64 MB RAM, 50 MB hard disk space.

Software required

Windows 95, 98, NT, 2000

Introduction

The product is described as 'a powerful application suite for creating secure surveys and tests for the web...'. Thus in today's climate of assessment at all stages of education this would appear to be a useful package – and I think it is!

Questionmark have been producing assessment software for a number of years and this latest offering allows one to create tests on stand-alone PCs, networks, intranets and the internet. The company has also been working closely with the 'testing community' to improve and augment their products and they are getting very good at it!

Computer assisted assessment

Computer assisted learning has its detractors, concerns over surface learning, the inability to show workings, the problem of reproducing the 'freedom' of paper-based examinations etc; but a tool which allows easy testing of students retention of knowledge, comprehension, application of methods etc (as in Bloom's Taxonomy) might well be a useful tool for the teacher.

Using the package

As well as the expected array of multiple choice questions, multiple response questions, calculations, hotspots, fill in the blanks, Perception also has explanation questions (which allow a large body of text to be included - eg for use in a CAL type exercise), matrix questions (select answer from a matrix of radio buttons), selection (users respond by using pull-down menus) and text match (user enters text into text field to answer question). The full list of question types is shown in fig 1 (extracted from the QMark web site).

Questions can be created using a Wizard (by far the easiest way to get started), from scratch by using the Question Editor or by copying from an existing question. Depending on the question type there are opportunities to enter the choices for the question, to identify the correct answer, to describe feedback after an attempt has been made to answer the question and how to assign a mark for the answer.

My one bugbear with the editing area is that unlike in earlier versions of (say) Question Designer, in order to create a hotspot question you have to use an external graphics editor then import the graphic and set the parameters required (previously you could use the internal graphics editor).

I created a small test with a multiple choice question, a multiple response question, a hotspot question and a calculation. Once a test is created it needs to be 'published' to a session so it can be used. This I did using the Session Manager. I then tried using the test on a stand-alone PC and it worked. Next I decided I had better see if I could get the same test to work over the web. I followed the instructions in the Perception Server manual and set up a test server on my Windows 2000 laptop using Microsoft's web server software (IIS version 5) and again it worked.

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	****
Documentation quality	*****
Academic content	****
Usefulness to student	***
Usefulness to teacher	****
Portability	***
Meets objectives	****
Accuracy	****

Roger Gladwin
LTSN Physical Sciences
Liverpool University
Liverpool
L69 7ZD
May 2002

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Questionmark Perception

Drag-and-Drop (WBA): the participant answers by dragging and dropping up to ten graphics into position.

Essay question (WBA and BBA): the participant answers by typing up to 30,000 characters of text. You may define what is right or wrong in advance by entering a list of acceptable answers or print out a report of the responses for manual grading. The logic can also allow scoring based on the presence or absence of keywords or key phrases. This question type is also used to solicit opinions or suggestions on a particular subject.

Explanation screens (WBA and BBA): insert text or graphics for the participant to view prior to answering a series of questions.

Fill-in-the-blank (WBA only): the participant is presented with a statement where one or more words are missing and completes the missing words. The score can be determined from checking each blank against a list of acceptable words and can be checked for mis-spelled words.

Hotspot (WBA only): a participant clicks on a picture to indicate their choice. Dependent upon their choice certain feedback and grades will be assigned. A graphics editor is provided to simplify specifying the choice areas. Drag and Drop: a participant clicks and drags up to ten images into position. The feedback and score is dependent upon the final position of the images.

Java (WBA): Perception supports an interface to Java to allow programmers to program customized items using Java and have the results recorded within the answer database.

Likert scale (WBA and BBA): the participant selects one choice from choices such as "strongly agree" through "strongly disagree" that are weighted with number to aid analysis of the results.

Macromedia Flash (WBA): Perception supports an interface to Macromedia Flash to allow programmers to program customized items using Flash and have the results recorded within the answer database.

Matching (WBA only): two series of statements/words are presented and the participant must match items from one list to items within the other list.

Multiple choice (WBA and BBA): the participant selects one choice from up to 40 possible answers. There is no limit to the length of each answer.

Multiple response (WBA and BBA): similar to multiple choice except the participant is not limited to choosing one response; he/she can select none, one or more of the choices offered.

Matrix (WBA only): this question type presents several multiple choice questions together where the participant selects one choice for each statement or question presented. This is question type is used to cross relate responses from a single item.

Numeric questions (WBA and BBA): a participant is prompted to enter a numeric value and this may be scored as one value for an exact answer and another score if the response is within a range.

Pull Down List (selection question) (WBA only): a series of statements are presented and the participant can match these statements with a pull-down list.

Ranking (Rank in Order) (WBA only): a list of choices must be ranked numerically with duplicate matches not allowed.

Select-a-blank (WBA only): the participant is presented with a statement where a word is missing and words can be selected from a pull down list to indicate their answer.

True/False (WBA and BBA): the participant selects "true" or "false" in response to the question.

Word response (text match) (WBA and BBA): the participant types in a single word, or a few words to indicate. You define right or wrong words or phrases in advance by entering a list of acceptable answers. The grading logic can also allow scoring based on the presence or absence of keywords or key phrases and check for mis-spellings.

Yes/No (WBA and BBA): the participant selects "Yes" or "No" in response to the question.

fig 1: Question types available in v3 for windows-based authoring (WBA) and browser-based authoring (BBA)

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Interoperability

If you are creating computer based assessment sets for your institution you may be interested in the Information Management Systems (IMS) Question and Test Interoperability (QTI) standards which should allow easy transfer of data between systems. Questionmark Perception has QTI import/export facilities. In addition the software is compliant with Sharable Content Object Reference Model (SCORM) 1.2. Perception's new SCORM support feature allows Learning Management Systems to launch Perception and track assessment results.

The suite

The package comes on a CDROM with three manuals, one for 'Getting Started', another is the 'Authoring Manual' and the final one covers 'Perception Server' for web-based assessment. For web-based assessment you will probably find the manual essential reading and you will need to be confident in working with security issues on servers,

setting up ODBC systems etc (otherwise you will need your computer services people). The final part of the suite to mention is the Reporter. This allows the administrator to see who has been attempting tests, their scores etc. The licence from QuestionMark will configure which parts of the system work for you and this will depend on what you have purchased.

Questionmark have also put a lot of resources on their web site (<http://www.qmark.com/perception/help>). These include case studies, a learning café, a chance to try the system, a download area and web seminars.

Since this review version 3 has been released.

Quiz Manager



Subject area

General.

Description

Network aware multiple choice Quiz Builder, Runner, Marker and Reporter.

Authors

Andrew Johnson.

Suppliers/Distributors

Double-Click Services Ltd.
(<http://www.quizmanager.co.uk>).

Date/Version

September 2001.

Level

A-level, access, undergraduate.

Type of Package

Grading/markings, exam preparation.

Price

30 Logins £50 to 300 logins £150.

Hardware required

PC Pentium 200 MHz 64 MB RAM.
A 10 Mb/s Local Area Network.

Software required

Windows

Derek M. Bloor
Salford University
School of Sciences (Chemistry)
Cockcroft Building
The Crescent
Salford
M5 4WT
April 2002

The area of student assessment in the form of testing is one that is continually subject to change, mainly due to the fact that everyone has their own personal viewpoint of a somewhat unreachable perfect solution. What is common to all assessment or testing procedures however is the marking and assignment of a suitable score for the completed test. It is this area together with the presentation of the test in which Quiz Manager excels in its own limited way. The use of the word limited is used here in a complementary way to illustrate the way in which Quiz Manager is competing in an arena of much more sophisticated (and of course far more expensive!) software, the ultimate example being Question Marks' Perception.

Quiz Manager sets out to solve a simple straightforward task, which is to present a quiz, mark the quiz and supply the question master with a comprehensive report of the student marks. This the software achieves within its own boundaries, summarised as follows.

The test is designed to take place at specific test location (exam room). The students use a networked computer in the room to complete the test, with an invigilator monitoring their progress using a control computer.

The only type of question that is really available to the examiner when compiling the test is the multiple choice type which may also include a picture if required. A question style requiring a word or phrase based answer is also available, however since this requires an exact, to the letter, response by the student, it is not really practicable.

Although questions may be selected and deselected by the quiz master to control which questions the student sees, there is no facility to generate a quiz (say of twenty questions) automatically by a random choice of questions from a test bank (of say one hundred questions). The students all therefore take identical tests in the same room at the same time and since the test is completed on a monitor screen the ease by which students may copy from each other is questionable compared with a paper based version.

The above are not what could be considered to be serious, and under normal circumstances a fairly easy 'work around' may be employed. To check to see just how useful this software is, we decided to set up a simple test with a small selection of students.

Once you have installed the software and started to watch the extremely useful 'Screen Cam' tutorials, the first thing that you realise is that you not only have to be computer literate, you also have to be network literate. If the words 'TCP/IP', 'IP Address' or 'Subnet Mask' mean little to you, the first thing you need to do is to find somebody who does, since without TCP/IP setup on your computer Quiz Manager cannot function. Once this is overcome and everything seems to be functioning you need to provide full share access to the network drive holding the student database. This must be established for all students taking the test to allow their score to be entered into the final report – I must admit, I am not happy with this part of the setup process, allowing students full share access to a network drive or folder is most certainly to leave it open to abuse.

Summary Review

range: * very poor to ***** excellent

Ease of use	***
Ease of learning	*****
Documentation quality	**
Academic content	***
Usefulness to student	***
Usefulness to teacher	*****
Portability	***
Meets objectives	*****
Accuracy	*****

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Quiz Manager

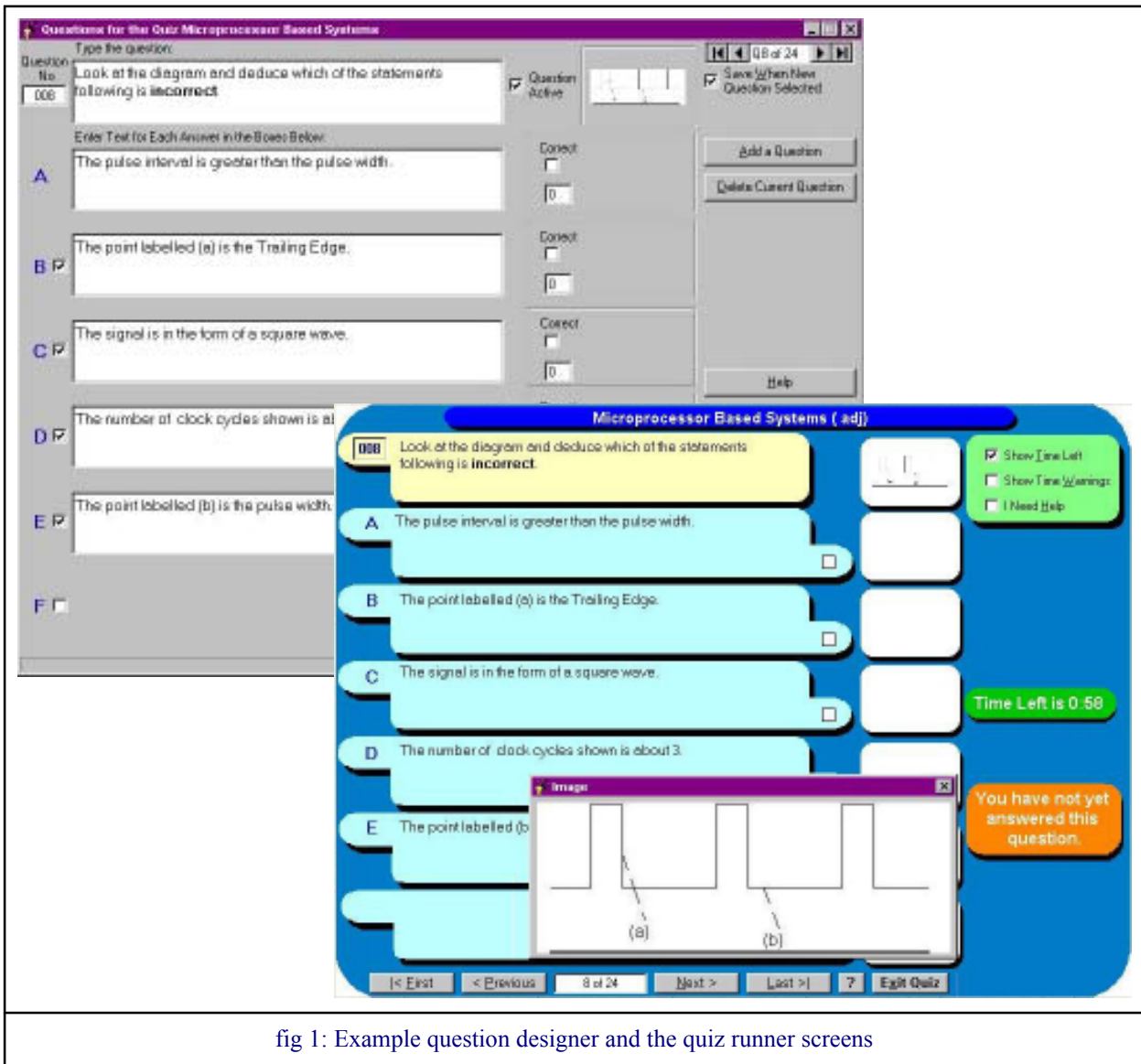


fig 1: Example question designer and the quiz runner screens

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The building of the quiz is the easy part, providing you can supply the questions and overall works extremely well. You simply provide the text of the question along with up to six possible multiple choice answers and place check marks against the correct answer(s) with the score allocated for making that particular choice. The test may then be undertaken by the student at the relevant time you set using client software (Quiz Runner) running on the students machines, you sit at the front of the class watching the progress of all the students you have allowed to sit the test. Information is displayed on the invigilators control machine allowing you see which question a particular student is currently attempting and whether they are having trouble and need help etc.

When the test has been completed, a comprehensive report may be generated. In total six types of report are available, documenting various statistics relating to the testing

data. I particularly liked the ability to produce answer sheets from the test so that it is possible to review the test at a later date, perhaps in a tutorial.

In the production of our test quiz environment, no real problems were encountered and overall the software does as expected, there are of course some deficiencies detailed above, but for the price (£50 for 30 logins to £150 for 300 logins) this is to be expected. I do feel however that this software should really be Web based and the fact that specific client software (Quiz Runner) has to be run on the student machine rather than the far more student friendly Explorer or Netscape client gives the program a somewhat dated feel. A demonstration CD version of the software is available from Double-Click Services Ltd for a paltry £6. If your interest lies in this direction and you wish to provide local classroom based testing (rather than internet based distance learning) I can recommend you take a look.



Subject area
Chemistry.

Description
Tutorials, database and computational module for equilibrium aspects of solution chemistry.

Authors
L.J. Pettit, K.J. Powell,
R.W. Ramette.

Suppliers/Distributors
Academic Software, Sourby Old
Farm, Otley, Yorks, LS21 2PW, UK.

Date/Version
1998/v1.0.

Level
Undergraduate.

Type of package
Computer assisted learning,
calculation.

Price
£120.

Hardware required
A PC capable of running Windows.
A CDROM drive.

Software required
Windows 95/98/ME/NT/2000/XP.

William R. Smith
School of Engineering
University of Guelph
Guelph, ON
Canada N1G 2W1
April 2002

SolEQ is a CDROM-based package for Windows-based PC's, presented as "a set of tutorials on solution equilibria, designed for personal or class use, as a stand-alone course on Acid-Base, or Metal-Ligand or Redox or Solubility Equilibria, or as a supplement to other resources available to the student." SolEQ consists of three main components: tutorials, an equilibrium constants database, and a computational module. The database module, *Mini-SCDatabase*, contains ligand-metal stability constant data, and is a subset of a full version called

SC-Database, available from the same vendor. The computational module, *Species*, calculates and graphically displays species distribution curves (speciation curves). There are 29 tutorials, covering the principles and applications of acid-base, redox, solubility, and metal-ligand chemistry in both homogeneous and heterogeneous systems. They are in a 'softbook format', grouped into modules, and graded according to difficulty. Some of the tutorial exercises are linked to use of *Mini-SCDatabase* and to *Species*.

SolEQ is very easy to navigate; the main page has a standard Windows toolbar at the top, three large buttons on the right, a sound on/off toggle button, and a language selection list. Toggling the sound on gives a verbal overview of the tutorials and a description of how to navigate the program. The toolbar contains icons to access the tutorials, the database and the speciation modules; a text editor (Notepad); a calculator; a 'Useful Data' module that contains a list of atomic weights, a list of solubility product values, a thermodynamic calculator, and a periodic table; Windows Help files; and background information on SolEQ.

The program nicely combines the tutorials with the database and computational modules. However, in spite of the hyperlinks within the tutorials, the first thing I did was print them out! I'm sure many students would proceed similarly, rather than simply click on the tabs on the program windows to turn the virtual pages.

There were some minor glitches with the Species module that could be improved. One involves logarithmic scaling of the vertical axis; linear scaling is the default, and if logarithmic scaling is selected it is awkward to switch back. Similarly, I found the selection of species whose concentrations are to be displayed is sometimes problematic.

Although a single thermodynamic basis underlies the principles of chemical reaction and phase equilibrium, the pedagogical treatment and computational implementation in different fields tends to be idiosyncratic. A principal reason for this is the fact that the computational treatment is motivated by the two different types of basic thermochemical data employed. On the one hand, physicists, chemical engineers, and some inorganic chemists and geochemists implement equilibrium calculations using free-energy data for each individual chemical species. On the other hand, analytical and aquatic chemists invariably employ equilibrium-constant data referring to specific chemical reactions. Although the equivalence of the two types of data and methods to convert one form to the other have been known for some time¹, this knowledge does not seem to be widely known in different fields. Thus, in one of the tutorials (Speciation) of SolEQ it is stated that there are two main approaches to calculate the concentrations of species at chemical equilibrium, one of which involves

Summary Review

range: * very poor to ***** excellent

Ease of use	****
Ease of learning	***
Documentation quality	***
Academic content	***
Usefulness to student	***
Usefulness to teacher	***
Portability	***
Meets objectives	****
Accuracy	***

SoIEQ

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“minimization of the free energy changes for the reactions, using species-related thermodynamic data”. Apart from the use of species-related data, this is an incorrect description of the approach; *any* method for calculating chemical equilibrium must minimize the *total system free energy*. The tutorial then goes on to state “For equilibria in solution it is difficult to obtain the thermodynamic data required”, further stating that this alternative method based on knowledge of the stability (equilibrium) constants is used in SoIEQ.

It is perhaps overly optimistic to expect that a tutorial of this type will advance the overall pedagogical treatment of the subject. In spite of its use of modern computation tools, the treatment tends to reflect the culture of the pre-computer era, when equilibrium calculations were performed by hand. For example, in the Section Heterogeneous Equilibrium Principles → Solubility and K_{sp} under the *Problems 1* tab, the aqueous solubility, S , of a compound A_xB_y is calculated from the equation

$$K_{sp} = (xS)^x(yS)^y \quad (\text{Equation 1})$$

This approach is motivated by the desire to be able to perform hand calculations; the inherent inaccuracies and their prevalence in general chemistry texts have recently been pointed out by Hawkes² and by Clark and Bonicamp³. (Equation (1) is only accurate when the compound is completely dissociated and sparingly soluble.) However, the issue is appropriately addressed elsewhere in the same tutorial, under the *Complete Dissoc.* tab; it would improve the presentation if some mention were made of this on the earlier page.

The tutorials could be improved by deficiencies relating to some issues involving the underlying fundamentals, eg:

- No plausible link is made between the free-energy minimization property of chemical equilibrium and the use of equilibrium constants: The *An Introduction* button of the Tutorials refers to the “extent of reaction principle” as a basis of thermodynamics; the *Dynamic Equilibria* tab refers to the energy minimizing property of equilibrium by means of the usual analogy with the mechanical equilibrium of a ball in a hollow. Clicking on the green *equilibrium* hyperlink on this page reveals the statement “A more rigorous treatment based on thermodynamics (tutorial ‘thermodynamics’) will indicate that equilibrium is defined by a system in which the net chemical driving force (free energy) is zero”. There being no hyperlink, I searched for the Thermodynamics tutorial and found it as a Level 2 topic under *Homogeneous Equilibria: Principles*. There, under the K^0 tab, it is stated that “If the reactants and products are at equilibrium it follows from the Gibbs-Duhem equation that $\Delta G = 0$ ”. This statement is at best not pedagogically useful, and at worst incorrect! The correct link is that minimization of the system free energy with respect to the extent of reaction variables leads to the equations $\delta G / \delta \xi_j \equiv \Delta G_j = 0$ for the reactions (ξ_j is the extent of reaction for reactant j); these equations in turn can be expressed in terms of equilibrium constants.

- The distinction between the mass-balance equations and the equilibrium conditions is not presented consistently. Under the *Meas. K* tab in *Homogeneous Equilibria: Principles*, clicking on the green *mass balance equations* hyperlink, the equations given are the result of substitution of the equilibrium conditions into the mass-balance equations, and should be denoted as such. Under the *Calculations* tab in the Introduction tutorial, the mass-balance equations themselves are given correctly.

- No mention is made of the charge balance equation in conjunction with the mass balance equations. This equation is sometimes also necessary in calculating equilibrium compositions.

- No mention is made of the use of the molality concentration scale, and the molarity scale is used throughout the tutorials. The former scale is used in practise for more precise calculations⁴.

- The tabs *Balancing 1* and *Balancing 2* in the *Redox Equilibria* tutorial reflect the historical preoccupation with single-reaction chemical systems and with chemical artifices for balancing equations. The half-reaction method discussed is incapable of application to multi-reaction systems, and is itself unnecessary for balancing a single chemical equation. For further details see Reference⁵.

- In *Solution equilibria* → *Heterogeneous equilibria* → *Solubility and K_{sp}* under the *Gas in Water* tab, after the statement that “the gases will begin to dissolve in the water, each independently of the others”, the expression $K_H = [X]/P_X$ is displayed, and P_X is defined as “the pressure/atmospheres of the gas in the gaseous phase”. P_X should be more precisely defined as the *partial pressure* of the gas (the mole fraction times the total pressure), and the “independence” is equivalent to ideality assumptions in both phases.

SoIEQ combines a set of tutorials based on the standard pedagogical treatment of ionic equilibrium, combined with a database and a speciation calculation program. As such, it forms a useful supplemental aid to students studying courses involving such material. A final comment is that a better way to implement the same material might be via a web site.

References

1. W.R. Smith and R.W. Missen, *Chemical Reaction Equilibrium Analysis*, Wiley-Interscience, New York, 1982; Krieger, Malabar, FL., 1991, Section 9.4.
2. S.J. Hawkes, *J. Chem. Educ.*, **75**, 1179–1181 (1998).
3. R.W. Clark and J.M. Bonicamp, *J. Chem. Educ.*, **75**, 1182–1185 (1998).
4. W. Stumm and J.J. Morgan, *Aquatic Chemistry*, 3rd ed., Wiley-Interscience, New York, 1996, p. 97.
5. Web site at <http://www.chemical-stoichiometry.net>

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