an AA′ system. The intervening AM, AB, and AA′ systems are easily displayed by the program. Non-first-order splitting generally is observed for two interacting protons when the ratio of the difference in chemical shift (F in Hz) to the coupling constant (J in Hz) is less than 10 ($F/J < 10$). The values for the chemical shifts and the relative intensity of the signals are calculated using a modified scheme described by J. Piper (*20*). The display centers the signals at 50 Hz in the NMR spectrum. The user inputs required are the difference in chemical shifts (F in Hz) of the two interacting protons and the coupling constant (J in Hz) of that interaction. A representative spectrum for an AB system is shown in Figure 5.

A listing of the PMRSIM program and accompanying instructions are available from the author. Requests should include a stamped ($0.50), self-addressed, 9 × 12 in. envelope.

Find-the-Pairs

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Find-the-pairs, a game for the Commodore 64, can help students to avoid the drudgery of memorizing such essential items as elemental names and symbols or conversion factors.

There are a number of things the beginning chemistry student must memorize that are crucial to success in chemistry: metric/metric and metric/English (and perhaps even English/English) conversion factors, or names and symbols of elements and of ions, for example. And although it is no fun to memorize these things, a game format can take some of the drudgery out of this activity.

Some years ago there was a TV game show in which pairs of prizes were hidden behind blocks of the game board. The contestants took turns selecting pairs of blocks to be removed, exposing the prizes. The object, of course, was to guess the locations of the pairs of prizes: the contestant who exposed a pair of washing machines won a washing machine. Find-the-Pairs is a variation on this type of game.

In Find-the-Pairs the player(s) attempt to guess the location of pairs. In addition, they must also indicate that what they have is or is not a pair. In this version of the game, a pair does not necessarily consist of two of the same items, but instead is a pair of equivalent items. For instance, "iron" and "Fe" are a pair of equivalent items—an element and its atomic symbol. Similarly, "4 × 9" and "36" are a pair. Correctly confirming a pair wins 20 points. Any incorrect answer loses 20 points.

The game may be played by one or two. For two players, the game is won by the player with the highest score when all pairs have been exposed. The single player tries for a maximum score, and is penalized by one point for each minute of elapsed time required to confirm a pair—the contestant is playing against the clock.

The game is fairly easy to play. After the players are asked for their names, playing instructions are provided if requested. The game board is drawn and one pair of letters, corresponding to the boxes to be viewed, is entered for each turn. The hidden items are shown and the player is asked, "Is this a pair?" The player enters y-or n. The computer affirms or denys the answer and updates the score. If the items were not pairs, or were not identified as such, they are hidden again. Next turn. The game ends when all pairs are exposed on the board. The final score(s) are shown and an option to play again is offered.

Find-the-Pairs was originally written to assist my freshman students learn the names and symbols of some common elements. But the program is written in a way that it could be used for any subject in which identification of pairs can be important. It could even be used by preschoolers if graphics symbols were used instead of words to create pairs. Very few changes are needed to customize the program: The name should be changed and new strings representing the pairs must be typed into data statements.

The screen blocks are 10 characters wide by four lines high. This limits single-line words to be used to 10 characters. However, there is no reason that cursor controls cannot be employed to create phrases or graphics patterns that fill the entire block. The routine that re-covers the blocks when a pair is not found will cover the entire block, not just a single line, so you can feel free to experiment.

Find-the-Pairs is fun to play and has a very wide range of possible educational applications. Any reader who would like a disk or tape (specify which) for the Commodore 64 and complete documentation for a version with elemental names and symbols as the pairs can send a check for $10 made out to the author at 300 S. West Avenue, El Dorado, AR 71730.

Information Storage and Retrieval Using a Microcomputer

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While there have been many publications dealing with the use of microcomputers in interactive instruction, experiment simulation, data manipulation, and instrument interfacing, much less appears to have been published (*21*, *22*) on exercises in undergraduate chemical courses to illustrate their use as a means of storing and retrieving information. Yet this is a particularly important application in education, industry, and elsewhere.

The exercises described here have been developed for use in association with various undergraduate chemistry courses with the aims of introducing students to this application and impressing upon them the importance of computer information databases, of enabling the students to assess their advantages and disadvantages, and of giving them some experience of simple yet typical application in a chemical context. The courses then go on to provide instruction in the use of nationally and internationally available databases for information retrieval (e.g., *Chemical Abstracts*) and examples of the use in industry of company databases, etc.

The exercises are based around an Apple II microcomputer coupled with two disk drives and a printer. They rely on the commercially produced Data Factory.[3] However, the idea and the topics can be adapted to other systems and programs (commercially and/or personally developed).

The Data Factory is a very versatile program that allows information (numerical and nonnumerical) to be stored in files of up to 88 fields of any length up to 239 characters. It incorporates facilities for establishing new files, adding data to existing files, inspecting and/or changing any entry in any field in any file, transferring information between files, deleting entries, searching any file for particular information, etc.

Students are provided with instruction sheets that: 1) review this particular use of computers in general and in chemistry in particular; 2) describe the capabilities of the Data Factory; 3) give background information about each application to be illustrated; and 4) explain what information they must obtain by using the data base disks provided. An outline of three such exercises follows:

Stock Control. A file of six searchable fields is used to simulate some of the information a large college department

[3] The Data Factory by William Passauer, Microlab, 2310 Skokie Valley Road, Highland Park, IL 60035.