The Sun and Solar Wind: A Search for the Beginning

Analyzing Tiny Samples Using Mass Spectrometry

STUDENT ACTIVITY

INSTRUCTIONS

PART 1
As a technician in a mass spectrometry laboratory it is important for you to know that mass spectra can be graphed with intensity on the y-axis and mass on the x-axis. Intensity can be regarded as the number of ions of a given mass. Assume that the "superheavy" element Di (see Student Activity "Analyzing Tiny Samples"), can be analyzed with a CRUDEE mass spectrometer. On the Reporting/Data Sheet, design a histogram that shows what the mass spectrum would look like, including numbers on the axes.

PART 2

1. As you become a more experienced mass spectroscopist, you learn that relative abundances of isotopes often are important in understanding mass spectrometric data. Now turn to some real isotopes, those of the element neon (Ne). Use a source—a standard reference book or an on-line source—as identified by your instructor to:
    a. Identify the five stable isotopes of Ne and enter their mass number, actual mass (in amu), and percent natural abundance in the table.
    b. Calculate the abundance of each isotope relative to that of the most abundant isotope and enter your results in the table.
    c. Answer question #1 on the Reporting/Data Sheet.

2. Mass spectra can also be graphed with relative intensity on the y-axis, where relative intensity refers to intensity relative to that of the most abundant isotope. Devise a histogram that would represent the mass spectrum of naturally occurring neon with relative intensity graphed on the y-axis. Make sure that you enter appropriate numbers on the axes.

PART 3
You are rapidly becoming an experienced mass spectroscopist. On the Reporting/Data Sheet, you will find a simulated mass spectrum of naturally occurring titanium. Consider this spectrum and answer the questions below the spectrum.

PART 4
You are now almost a full-fledged member of the team and you know that mass spectra are very useful for identifying ions by determining their mass. On the Reporting/Data Sheet you will find a simulated mass spectrum of an element. Your boss has asked you to determine the identity of the material that gave the spectrum. On the Reporting/Data Sheet list the steps that you would take to identify the material. Now follow these steps and report the element's identity on the Reporting/Data Sheet.

PART 5
As an increasingly experienced mass spectroscopist, you also know that mass spectra can be very useful in identifying the components of a mixture. Your boss now has great confidence in you as a mass spectroscopist and brings to you a sample that is known to contain three different elements. He also tells you that the spectra were obtained in a laboratory that used outdated, poorly tuned equipment; consequently, he thinks that the equipment was unable to detect ions having intensities of less than about 5. The spectrum is shown on the Reporting/Data Sheet. Analyze the spectrum to determine the identities of the elements in the mixture.

PART 6

You now have been promoted to director of the lab and have overseen the design and construction of a mass spectrometer that has been on board a spacecraft that has sampled the solar wind. The results are in your hands in the form of the spectrum shown on the Reporting/Data Sheet (these are actual data obtained by the WIND Spacecraft). Below the spectrum write a brief report in which you identify the major components—labeled 1, 2,...8—of the solar wind sample.