53. Applying Models In discussions of the photoelectric effect, the minimum energy needed to remove an electron from the metal is called the *threshold energy* and is a characteristic of the metal. For example, chromium, Cr, will emit electrons when the wavelength of the radiation is 284 nm or less. Calculate the threshold energy for chromium. (Hint: You will need to use the two equations that describe the relationships between wavelength, frequency, speed of light, and Planck's constant.)

54. Analyzing Information Four electrons in an atom have the four sets of quantum numbers given below. Which electrons are in the same orbital? Explain your answer.

a. 1, 0, 0, −__
b. 1, 0, 0, +__
c. 2, 1, 1, +__
d. 2, 1, 0, +__

55. Relating Ideas Which of the sets of quantum numbers below are possible? Which are impossible? Explain your choices.

a. 2, 2, 1, +__
b. 2, 0, 0, −__
c. 2, 0, 1, −__

USING THE HANDBOOK

56. Sections 1 and 2 of the *Elements Handbook* contain information on an analytical test and a technological application for Group 1 and 2 elements. The test and application are based on the emission of light from atoms. Review these sections to answer the following:

a. What analytical technique utilizes the emission of light from excited atoms?
b. What elements in Groups 1 and 2 can be identified by this technique?
c. What types of compounds are used to provide color in fireworks?
d. What wavelengths within the visible spectrum would most likely contain emission lines for barium?

RESEARCH & WRITING

57. Neon signs do not always contain neon gas. The various colored lights produced by the signs are due to the emission of a variety of low-pressure gases in different tubes. Research other kinds of gases used in neon signs, and list the colors that they emit.

58. Prepare a report about the photoelectric effect, and cite some of its practical uses. Explain the basic operation of each device or technique mentioned.

ALTERNATIVE ASSESSMENT

59. Performance A spectroscope is a device used to produce and analyze spectra. Construct a simple spectroscope, and determine the absorption spectra of several elemental gases. (Your teacher will provide you with the gas discharge tubes containing samples of different gases.)

extension

Graphing Calculator **Calculating Quantum Number Relationships**

Go to **go.hrw.com** for a graphing calculator exercise that asks you to calculate quantum number relationships.

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