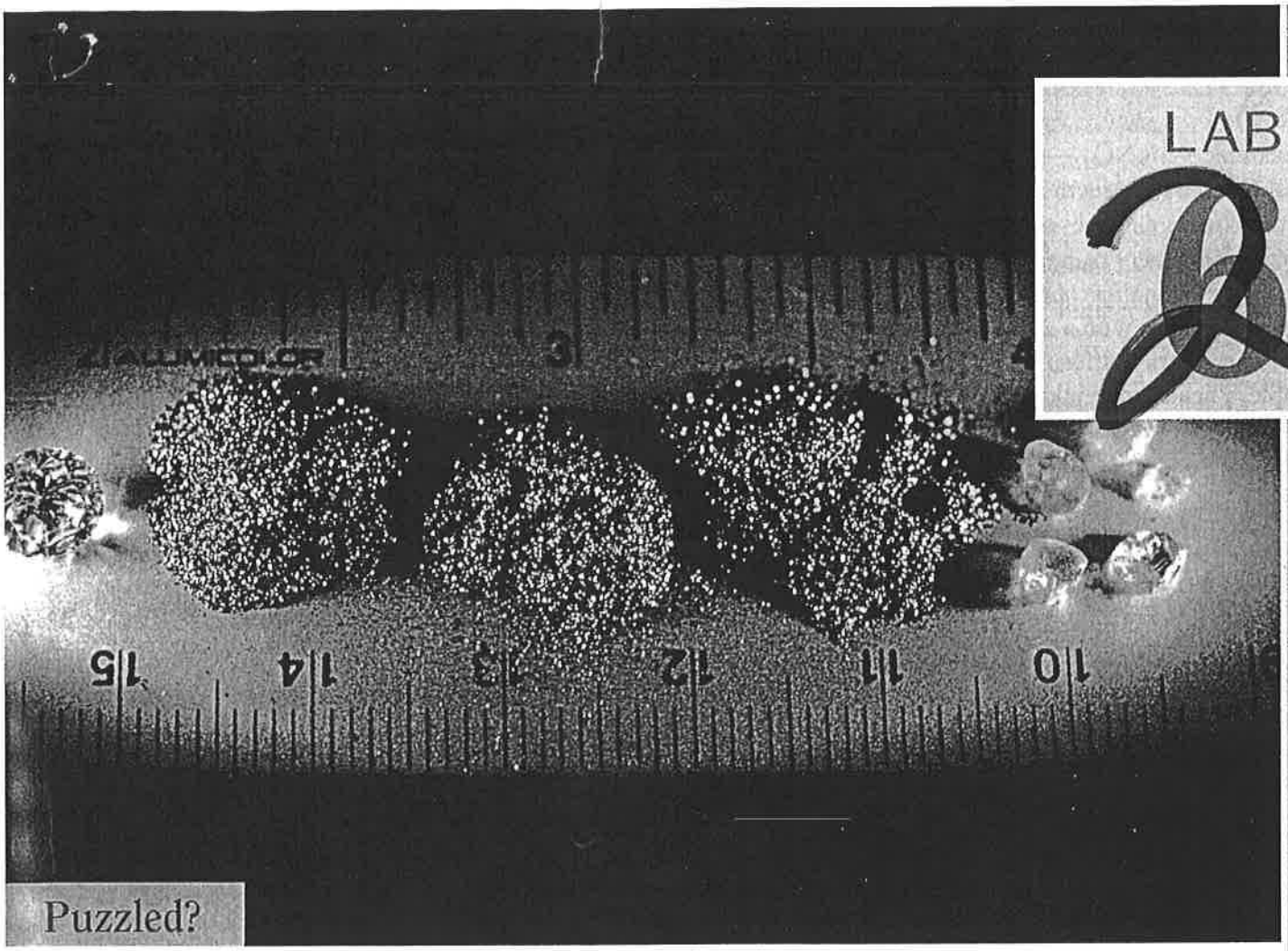

LAB 8

Puzzled?

Ionic and Covalent Bonds

Objectives

After completing this lab you should be able to:

- Identify the formula of a simple binary ionic compound from its constituent ions or its name.
- Name a simple binary ionic compound from its constituent ions or formula.
- Recognize the typical bonding patterns of second period nonmetals.
- Identify the relationships between the position of a nonmetal on the periodic table, the number of valence electrons it possesses, and the number of covalent bonds it typically forms.
- Apply your knowledge of bonding patterns for nonmetals to quickly generate reasonable Lewis structures from a molecular formula.

There are two major classes of compounds: ionic and covalent. Typical **ionic compounds** result from bonding between a positively charged metal **cation** and a negatively charged **anion** consisting of one or more nonmetals. (Nonmetals may also form cations, but these are less common and are not considered in this lab). Ionic compounds have a neutral overall charge because the constituent ions combine in a ratio that balances the positive charge from the cation with the negative charge from the anion. This ratio is indicated by the subscripts in a chemical formula. Ionic compounds are named by combining the name of the cation with the name of the anion.

Consider a typical ionic compound such as $Mg(NO_3)_2$. The cation (Mg^{2+}) carries a net charge of 2+ and is called the *magnesium ion*. The anion (NO_3^-) includes more than one nonmetal and is therefore a **polyatomic ion**. It carries a net 1− charge and is called *nitrate*. When the two ions combine to produce a compound, two negatively charged nitrate ions are required to balance the 2+ charge of a single magnesium ion. Thus, the cation and anion combine in a 1:2 ratio, and the formula for the compound is $Mg(NO_3)_2$.

Procedure

Part A: The Puzzle of Ionic Compounds

Your task is to form each of the 16 possible compounds from the puzzle pieces provided at the end of this book. Fill in the table on the data sheet, pages 81–86, for each compound. The rules for the ionic bonding puzzle are:

1. The charges on the cation puzzle pieces are represented conceptually using peaks. The number of peaks on a cation piece matches the charge of the cation.
2. The charges on the anion puzzle pieces are represented conceptually using valleys. The number of valleys on an anion pieces matches the charge of the anion.
3. Neutral ionic compounds are formed by matching the number of positive charges on a given cation with an equal number of negative charges on an anion.

A compound is modeled with the puzzle pieces by combining the appropriate number of pieces of a given cation with the appropriate number of pieces of a given anion such that all the peaks are matched with a corresponding valley. An example is given in Figure 6.1. Note that for the purposes of this exercise, you should not form compounds that contain more than one type of cation or more than one type of anion.

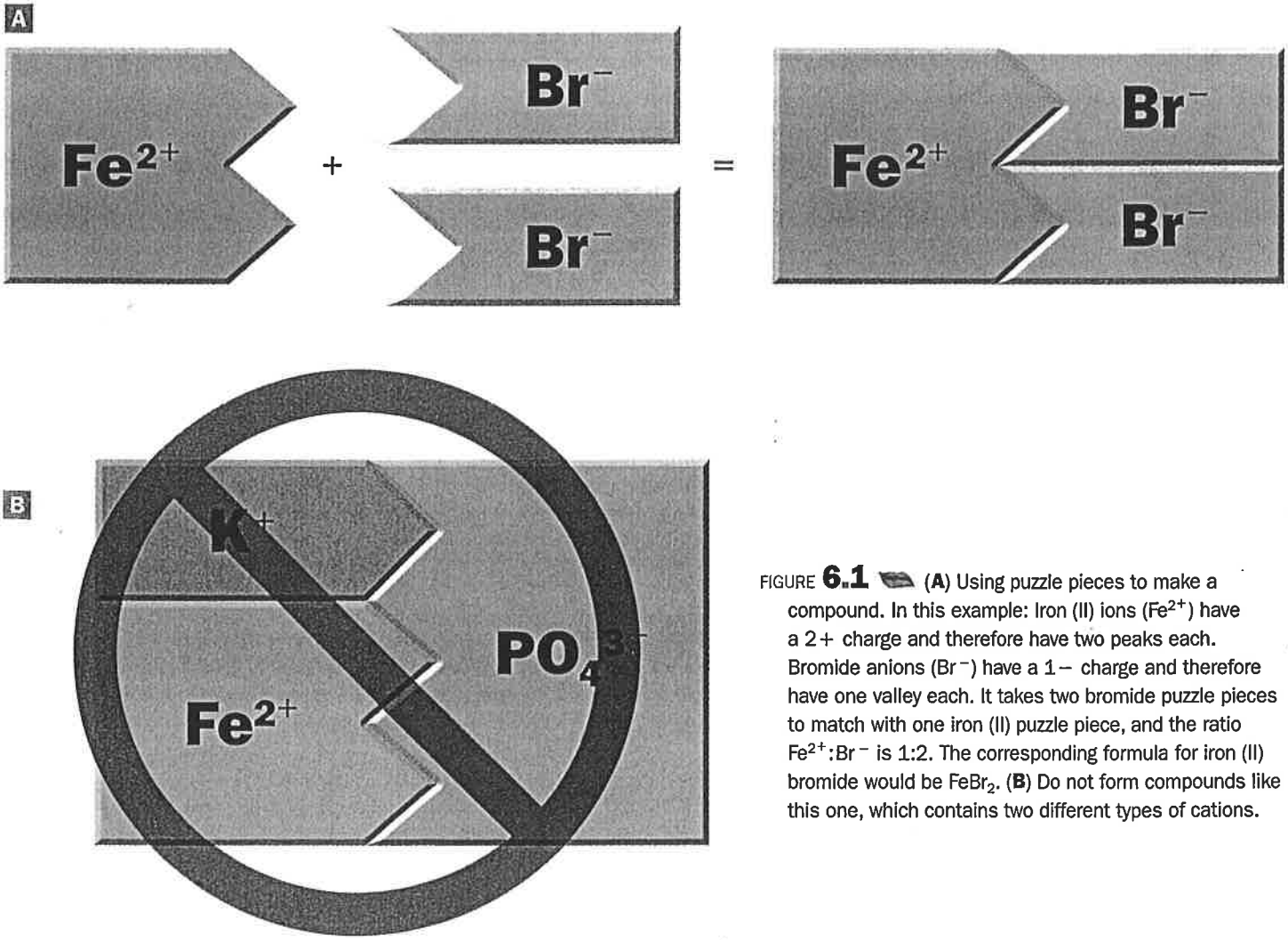

FIGURE **6.1** (**A**) Using puzzle pieces to make a compound. In this example: Iron (II) ions (Fe^{2+}) have a 2+ charge and therefore have two peaks each. Bromide anions (Br^-) have a 1− charge and therefore have one valley each. It takes two bromide puzzle pieces to match with one iron (II) puzzle piece, and the ratio $Fe^{2+}:Br^-$ is 1:2. The corresponding formula for iron (II) bromide would be $FeBr_2$. (**B**) Do not form compounds like this one, which contains two different types of cations.

4 Consider the magnesium ion (Mg^{2+}) and the sulfate anion (SO_4^{2-}).

a How many sulfate ions are necessary to balance the charge on one magnesium ion?

b Given your answer to (a), what should be the formula for the compound formed between Mg^{2+} and SO_4^{2-}?

c What should be the name of the compound formed between Mg^{2+} and SO_4^{2-}?

5 In a Lewis structure, each pair of electrons shared between nuclei (i.e., bonding pairs) may be represented by a line rather than dots. Any unshared electrons (i.e., nonbonding pairs) are usually represented as dots. Use the electron dot structure of the compound below to answer the following questions.

a Draw a Lewis structure of this compound using lines for bonding electrons.

b Is the octet of nitrogen satisfied in this structure?

c How many total bonds does the nitrogen possess?

d Is the bond between the nitrogen and hydrogen identical to the bond between the nitrogen and the oxygen? If not, what is the difference?

e How many of each bond type (i.e., single, double, or triple) does nitrogen possess?

Compound 4		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 5		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 6		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 9		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 10		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 11		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 14		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 15		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		

Compound 16		
	Cation Piece	Anion Piece
Ion charge		
Ion name		
Number of ions required		
Compound formula		
Compound name		