AIM 28 | Why do certain elements link up to form compounds?

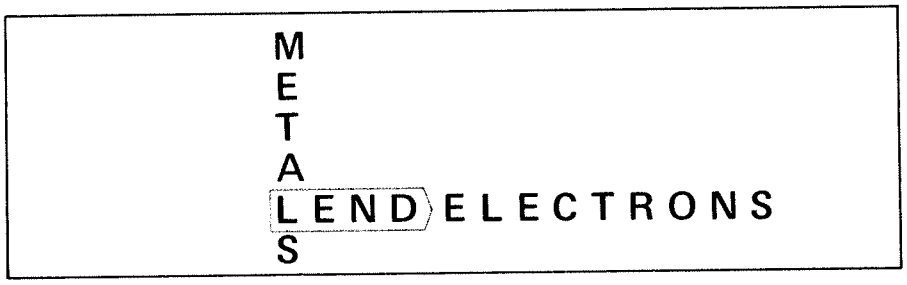
Now that you know about electron shells, you can understand more about why atoms link up.

Atoms that link up have outer shells that are not full. The atoms link up by gaining or losing the outer-ring electrons. A total of 8 outer-ring electrons is needed.

> For example, an atom with 7 outer-ring electrons will form a compound with an atom with 1 outer-ring electron [7 + 1 = 8]. [See Figure A, page 177.]
>
> An atom with 6 outer-ring electrons will link up with an atom with 2 outer-ring electrons. [6 + 2 = 8]. [See Figure B, page 178.]

The number of outer-ring electrons tells us if an atom is a metal or nonmetal. Atoms of *metals have fewer than 4 electrons in the outer ring.* Atoms of *nonmetals have more than 4 electrons in the outer ring.*

When forming compounds, metals "lend" electrons. Nonmetals "borrow" electrons. A compound has at least one metal and one nonmetal.



Some atoms do not link up with any other elements. And not every atom that *can* combine with another kind of atom *will* combine with the other atom.

DRAWING A COMPOUND

Information about two compounds is given below. Study the information and then look at the drawing of each compound. Try to answer the questions about each compound.

1. Sodium (Na) and chlorine (Cl) link up to form the compound sodium chloride (NaCl). This is table salt.

SODIUM (Na)

Atomic number = 11
Atomic weight = 23
Protons = 11
Neutrons = 12
Electrons = 11

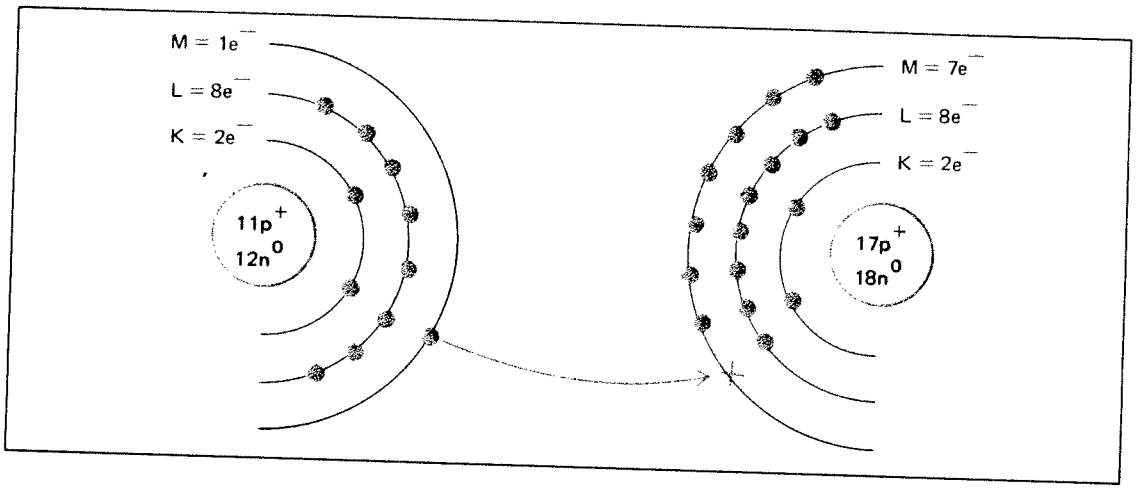
K = $2e^-$
L = $8e^-$
M = $1e^-$

CHLORINE (Cl)

Atomic number = 17
Atomic weight = 35
Protons = 17
Neutrons = 18
Electrons = 17

K = $2e^-$
L = $8e^-$
M = $7e^-$

A.



1. a) How many outer-ring electrons does sodium have? _____

b) Is the outer shell full? _____

c) Is sodium a metal or a nonmetal? _____

2. a) How many outer-ring electrons does chlorine have? _____

b) Is this a full outer shell? _____

c) Is chlorine a metal or a nonmetal? _____

3. a) Altogether, how many outer-ring electrons do sodium and chlorine have? (Count them.) _____

b) Together, do they make a full shell? _____

4. Which atom is the electron "lender"? _____

5. How many electrons are lent? _____

6. Which atom borrows the electron? _____

7. How many electrons are borrowed? _____

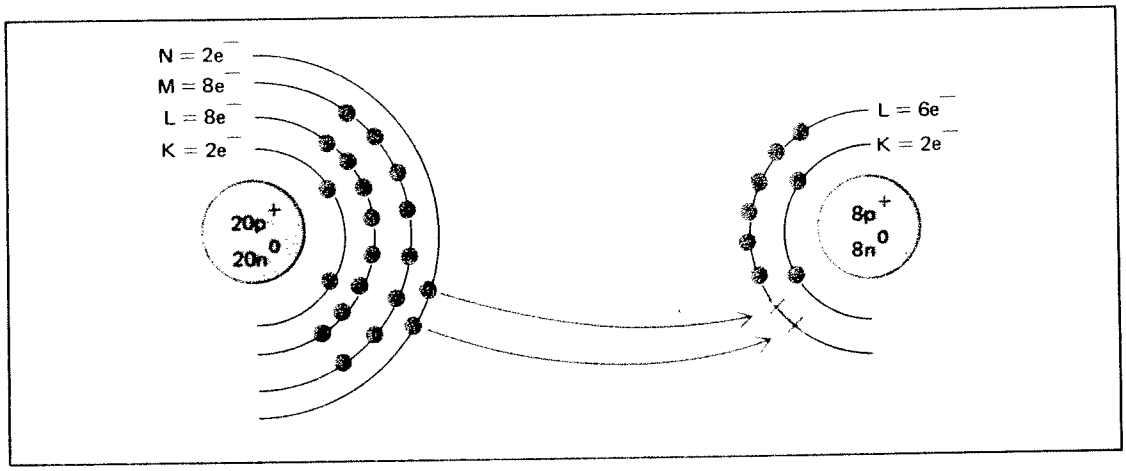
8. What is formed, a mixture or a compound? _____

9. When sodium and chlorine link up, do their properties change? _____

II. Calcium and oxygen join to form the compound calcium oxide (CaO).

CALCIUM (Ca)		*OXYGEN* (O)	
Atomic number = 20		Atomic number = 8	
Atomic weight = 40		Atomic weight = 16	
Protons = 20		Protons = 8	
Neutrons = 20		Neutrons = 8	
Electrons = 20	K = $2e^-$ L = $8e^-$ M = $8e^-$ N = $2e^-$	Electrons = 8	K = $2e^-$ L = $6e^-$

B.



1. **a)** How many outer-ring electrons does calcium have? _____

   b) Is the outer ring full? _____

   c) Is calcium a metal or nonmetal? _____

2. **a)** How many outer-ring electrons does oxygen have? _____

   b) Is this a full shell? _____

   c) Is oxygen a metal or a nonmetal? _____

3. **a)** Altogether, how many outer-ring electrons do calcium and oxygen have? (Count them.) _____

   b) Together, do they make a full shell? _____

4. Which atom lends electrons? _____

5. How many electrons are lent? _____

6. Which atom borrows the electrons? _____

7. How many electrons are borrowed? _____

8. What is formed, a mixture or a compound? _____

9. When calcium and oxygen link up, do their properties change? _____

Remember:

1. *Metals* have *fewer than 4* electrons in the outer ring.
2. *Nonmetals* have *more than 4* electrons in the outer ring.
3. Metals lend electrons.
4. Nonmetals borrow electrons.
5. A total of 8 *shared* outer-ring electrons are needed to make a compound.

CHOOSE ONE — Choose the correct word or term for each statement. Write your choice in the space.

1. A compound is formed when outer-ring electrons _____ (separate, link up).

2. A compound needs a total of _____ (2, 8) outer-ring electrons.

3. The outer-ring electrons of a compound come from _____ (one atom, two or more different atoms).

4. The outer ring of a metal has _____ (fewer, more) than four electrons.

5. Metals _____ (lend, borrow) electrons.

6. The outer ring of a nonmetal has _____ (fewer, more) than four electrons.

7. Nonmetals _____ (lend, borrow) electrons.

8. Most elements are _____ (metals, nonmetals).

COMPLETING THE CHARTS

In each of the charts below, fill in the missing information. Use the Periodic Table to help. The first element, calcium, has already been done for you in chart I.

I.

Element	Number of Electrons in Outer Ring	Metal or Nonmetal?	Electron Lender or Borrower?	Lends or Borrows How Many Electrons?
1. calcium	2	metal	lender	2
2. copper				
3. phosphorus				
4. potassium				
5. oxygen				
6. iodine				
7. gold				
8. bromine				
9. sulfur				
10. cobalt				

11.

Elements of Group	Lend Electrons (Choose Either)	Borrow Electrons (Choose Either)	Metal or Nonmetal
IA	✓		metal
IIA			
IIIB			
IVB			
VB			
VIB			
VIIB			
VIII			
IB			
IIB			
VIIA			

Notice that some of the groups are missing from this chart. This is because some of the groups contain both metals and nonmetals.

The step-like black line on the Periodic Table separates the metals from the nonmetals. The elements to the left of the line are metals. The elements to the right are nonmetals.

The elements in Group O do not lend nor borrow electrons. Because they do not combine with other elements they are often called the *noble gases*.

PAIRING GROUPS

Use the Periodic Table to answer these questions:
Remember a *total* of 8 outer electrons are needed to make a compound.

1. Elements of Group IA link up with the elements of Group _____.
2. Elements of Group IIA form compounds with the elements of Group _____.
3. Atoms of Group IB combine with the atoms of Group _____.
4. The elements that do not combine with other elements are those of Group _____.

MATCHING Match the two lists. Write the correct letter on the line next to each number.

1. _____ metals
2. _____ eight
3. _____ sodium and chlorine
4. _____ hydrogen and oxygen
5. _____ nonmetals

a) link up to form water

b) link up to form salt

c) number of outer-ring electrons needed to form a compound

d) borrow electrons

e) lend electrons

TRUE OR FALSE Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

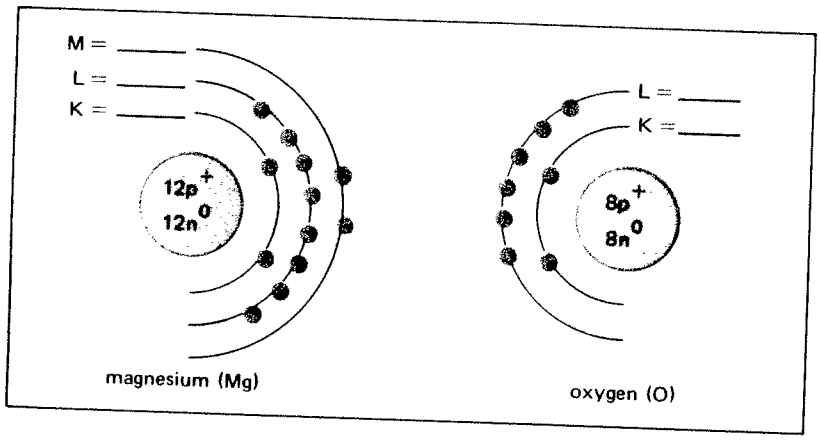
1. _____ Atoms with fewer than 4 outer electrons lend electrons.
2. _____ Atoms with more than 4 outer electrons borrow electrons.
3. _____ Metals lend electrons.
4. _____ Nonmetals lend electrons.
5. _____ Electrons from inner shells link up to form compounds.
6. _____ Only outer shells gain or lose electrons with other atoms.
7. _____ All atoms form compounds.
8. _____ Every element can link up with every other element.

COMPLETE THE DIAGRAMS

a) Fill in the missing parts or information on each diagram below.
b) Then show how the atoms link up.

Magnesium and Oxygen

A.



1. Which atom is **a)** the lender? _____

b) the borrower? _____

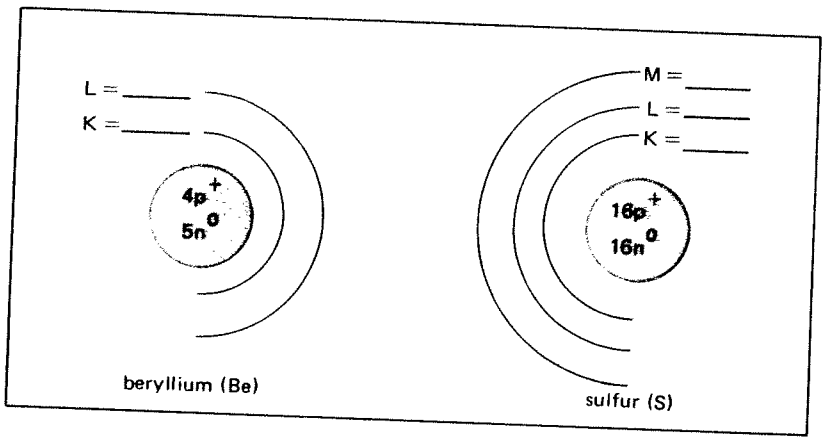
c) the metal? _____

d) the nonmetal? _____

2. The formula for this compound is MgO. In a compound, the first element is a _____ .
metal, nonmetal

Beryllium and Sulfur

B.



3. Which atom is

a) the lender? _____

b) the borrower? _____

c) the metal? _____

d) the nonmetal? _____

4. What is the formula for this compound? _____

PERIODIC TABLE OF ELEMENTS