Target Reading Skill

Compare and Contrast

Complete the compare-contrast table on Types of Chemical Bonds.

<table>
<thead>
<tr>
<th>Type of Chemical Bond</th>
<th>How Bonds Form</th>
<th>Charge on Bonded Atoms</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ionic bond</td>
<td>a. ?</td>
<td>Yes; positive and negative</td>
<td>b. ?</td>
</tr>
<tr>
<td>Polar bond</td>
<td>Unequal sharing of electrons</td>
<td>c. ?</td>
<td>d. ?</td>
</tr>
<tr>
<td>Nonpolar bond</td>
<td>e. ?</td>
<td>f. ?</td>
<td>O₂ molecule</td>
</tr>
<tr>
<td>Metallic bond</td>
<td>g. ?</td>
<td>yes; positive</td>
<td>h. ?</td>
</tr>
</tbody>
</table>

Reviewing Key Terms

Choose the letter of the best answer.

1. Valence electrons in an atom are those that are
   a. held most loosely.
   b. of the lowest energy level.
   c. always easily lost.
   d. never easily lost.
2. An electron dot diagram shows an atom’s number of
   a. protons.
   b. electrons.
   c. valence electrons.
   d. chemical bonds.
3. When an atom loses or gains electrons, it becomes a(n)
   a. ion.
   b. formula.
   c. crystal.
   d. subscript.
4. A covalent bond in which electrons are shared unequally is a
   a. double bond.
   b. triple bond.
   c. polar bond.
   d. nonpolar bond.
5. The metal atoms in stainless steel are held together by
   a. ionic bonds.
   b. polar bonds.
   c. covalent bonds.
   d. metallic bonds.

Complete the following sentences so that your answers clearly explain the key terms.

6. When atoms react, they form a chemical bond, which is ________.
7. Polyatomic ions such as ammonium ions (NH₄⁺) and nitrate ions (NO₃⁻) are ions that consist of ________.
8. Magnesium chloride is an example of an ionic compound, which means a compound composed of ________.
9. The formulas N₂, H₂O, and CO₂ all represent molecules, which are defined as ________.
10. Pure metals tend to be weaker and more reactive than an alloy, which is a ________.

Comparing and Contrasting

Go to your local grocery store and observe how the products on the shelves are organized. Write a paragraph comparing how foods are organized in a grocery store and how elements are organized in the periodic table.

Video Assessment

Video Assessment: Atoms and Bonding

Show the Video Assessment to review chapter content and as a prompt for the writing assignment. Discussion questions:

What do the elements in a single group on the periodic table have in common? (They have the same number of electrons in their outer shell.) Where are the most reactive elements located on the periodic table? (In Groups 1 and 17)
Checking Concepts

11. An element whose atoms have eight valence electrons is less reactive, because it does not require any additional electrons to become stable.

12. Because a lot of energy is required to break their strong ionic bonds.

13. Two atoms of hydrogen, one atom of sulfur, and four atoms of oxygen.

14. An ionic bond forms as a result of an attraction between oppositely charged ions. A covalent bond forms when two atoms share one or more pairs of electrons.

15. Because each atom exerts the same pull on the shared electrons.

16. The valence electrons in metals are only loosely held by the positively charged ions, allowing them to move freely among the ions and conduct electricity.

Thinking Critically

17. Sample answer: Elements within the same group have the same number of valence electrons in their atoms, and the number of valence electrons determines how elements react. The reactivity of metals decreases from left to right across the table. The Group 17 elements are the most reactive nonmetals. The Group 18 elements are the least reactive elements of all.

18. Both molecules are nonpolar. The oxygen atoms in the oxygen molecule pull equally on the shared electrons. The oxygen atoms in carbon dioxide each pull more strongly than the carbon atom does, creating polar bonds. But the oxygen atoms pull in opposite directions, so the polar bonds cancel each other out.

19. Because water is polar, water molecules have positive and negative ends. This causes water molecules to be attracted to one another and form a liquid at room temperature. Nonpolar molecules, lacking this type of attraction, can move farther apart and form a gas at room temperature.

20. Because the horseshoe is metal, pounding it causes the positive metal ions to change position, but the metallic bonds between the ions and the freely moving valence electrons keep the metal ions from breaking apart.

Applying Skills

21. There will be three hydrogen atoms to one nitrogen atom. That combination gives the nitrogen atom eight valence electrons and each hydrogen atom two valence electrons.

22. Sodium can become stable by losing one electron, leaving it with eight electrons in its next level.

23. Argon is least likely to react; it has a stable set of eight valence electrons.

24. Oxygen would react with two atoms of sulfur to form an ionic compound. An oxide ion has a charge of 2− and needs two sodium ions, each with a 1+ charge, to balance it.

25. Covalent bonds form in both cases. A triple bond forms when two atoms of nitrogen join, and a double bond forms when two atoms of oxygen form.
Choose the letter of the best answer.

1. What is the atomic number of calcium?
A 6
B 20
C 40.08
D 48

2. Which element is the most likely to lose two electrons and form an ion with a charge of 2+?
A potassium (K)
B oxygen (O)
C magnesium (Mg)
D aluminum (Al)

3. Oxygen has 6 valence electrons, as indicated by the 6 dots around the letter symbol “O.” Based on this information, how many covalent bonds could an oxygen atom form?
A six
B three
C two
D none

4. If a reaction occurs between potassium (K) and oxygen (O), what will be the ratio of potassium ions to oxide ions in the resulting compound, potassium oxide?
A 1 : 1
B 1 : 2
C 2 : 1
D 2 : 2

5. The element boron (B) is directly above aluminum (Al) on the periodic table. Which statement about boron is true?
A Boron is in the same period as aluminum and has two valence electrons.
B Boron is in the same group as aluminum and has two valence electrons.
C Boron is in the same period as aluminum and has three valence electrons.
D Boron is in the same group as aluminum and has three valence electrons.

6. An ice cube (solid H₂O) and a scoop of table salt (NaCl) are left outside on a warm, sunny day. Which best explains why the ice cube melts and the salt does not?
A The attractive forces between molecules of H₂O are much weaker than those between ions in NaCl.
B NaCl can dissolve in H₂O.
C The mass of the H₂O was less than the mass of the NaCl.
D NaCl is white and H₂O is colorless.

7. In a crystal of sodium chloride, each sodium ion is attracted to the
A other sodium ions surrounding it.
B chloride ions surrounding it.
C neutral sodium atoms surrounding it.
D neutral chlorine atoms surrounding it.

8. Valence electrons—potassium, 1; calcium, 4; aluminum, 3; oxygen, 6; iodine, 7. KI, CaO, AlI₃, K₂O. S 8.3.b, 8.3.f

Performance Assessment In their presentations, students should describe how their models represent atoms, bonds, and compounds. They should note any differences and consider how the differences affect the quality and usefulness of the models. To help improve their models, students might say they would like to know more about relative sizes of atoms of different elements or more about the modern atomic model.

Teaching Resources

Standards Practice

1. B; S 8.3.f
2. C; S 8.3.b
3. C; S 8.3.b
4. C; S 8.3.b
5. D; S 8.3.f
6. A; S 8.3.c
7. B; S 8.3.c

Apply the Big Idea

8. Use the periodic table to find the number of valence electrons for potassium (K), calcium (Ca), aluminum (Al), oxygen (O), and iodine (I). Then write the formulas for the following compounds: potassium iodide, calcium oxide, aluminum iodide, and potassium oxide. S 8.3.b, 8.3.f

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