

Name: _____ Block: _____ Date: _____

Problem Set #5 Solutions (U1, L25-26)

Concepts/Vocabulary: Fill in the blanks or circle the correct response in brackets.

1. Elements toward the bottom left corner of the periodic table are called ___ **metals** ___ and have a relatively [strong] [**weak**] hold on their outermost electrons.
2. Elements toward the top right corner of the periodic table are called ___ **non-metals** ___ and have a relatively [**strong**] [weak] hold on their outermost electrons.
3. When many ___ **metals** ___ atoms get together, they share electrons in a common pool. This is known as ___ **metallic** ___ bonding.
4. When atoms of metals and nonmetals get together, the ___ **non-metal** ___ atoms steal electrons from the ___ **metal** ___ atoms. They then stick together. This is known as ___ **ionic** ___ bonding.
5. When ___ **non-metal** ___ atoms get together, they share electrons in pairs between two atoms at a time. This is known as ___ **covalent** ___ bonding.
6. Covalent bonding can lead to two types of substances.
 - (a) ___ **network** ___ covalent substances are solids in which all the atoms are covalently bonded into a continuous grid.
 - (b) In ___ **molecular** ___ covalent substances, atoms are covalently bonded into groups that form small, stable units.

Problems:

7. The terminals of a car battery are sometime made of iron Fe(s). If the iron rusts, it turns to iron (III) oxide, Fe₂O₃(s), and no longer conducts electricity, so the battery may not work anymore. The interior of the battery consists of a solution.
 - (a) Explain why iron is able to conduct electricity.

Iron atoms are held together by metallic bonds. The iron atoms have a weak hold on their valence electrons and the nucleus of each iron atom is attracted to this shared pool, holding the atoms together as a solid. Because the hold on the valence electrons is weak, the electrons are free to flow, which means the substance can conduct electricity.

- (b) Explain why rust cannot conduct electricity.

Rust is comprised of iron, a metal, and oxygen, a non-metal. This makes the bonding type ionic. In ionic bonding, valence electrons are held tightly by the individual ions and are not free to flow (unless they are in solution). This means rust cannot conduct electricity.

- (c) What kind of particles must the solution inside the battery contain in order to conduct electricity? Explain.

The solution must contain ions. When ionic compounds dissolve, the individual ions split apart. These ions (which you can think of as charges) can conduct electricity. Be careful, it isn't just the metal ion that can carry charge, both the metal and non-metal ions are responsible for the conductivity of ionic compounds in solution.

8. You observed nitrogen dioxide, $\text{NO}_2(\text{g})$, during the copper cycle experiment. How would you characterize the bonding in NO_2 ? Explain.

The type of bonding is molecular covalent. Nitrogen dioxide is made up entirely on non-metals, so the bonding type must be covalent. We know it is molecular covalent and not network covalent for 2 reasons: it isn't diamond, graphite, or sand (the common network covalent substances) and it is a gas (only molecular covalent substances are gases at this temperature).

9. Predict whether each substance listed will conduct electricity on its own, dissolve in water, and conduct electricity once it has dissolved. Circle your choices. Then explain your thinking in each case.

- (a) Acetone ($\text{C}_3\text{H}_6\text{O}(\text{l})$) [will/will not] conduct electricity on its own.

It [will/will not] dissolve in water.

If it dissolves, then the solution [will/will not] conduct electricity.

Explanation:

Acetone is made of only non-metal atoms, so it must be covalent bonding. In this case, it is molecular covalent since it is not graphite, diamond, or sand. Molecular covalent substances can dissolve in water and will never conduct electricity.

- (b) Titanium ($\text{Ti}(\text{s})$) [will/will not] conduct electricity on its own.

It [will/will not] dissolve in water.

If it dissolves, then the solution [will/will not] conduct electricity. **N/A**

Explanation:

Titanium atoms are held together by metallic bonding. The valence electrons are shared in a pool so they are free to flow, which allows them to conduct electricity. Metals do not dissolve in water.

- (c) Lithium nitrate ($\text{LiNO}_3(\text{s})$) [will/will not] conduct electricity on its own.

It [will/will not] dissolve in water.

If it dissolves, then the solution [will/will not] conduct electricity.

Explanation:

Lithium nitrate is composed on metal and non-metals atoms, therefore the bonding type is ionic. The valence electrons are held by the individual ions, so they are not free to conduct electricity. The ions split when dissolved in water and can then carry charge (meaning it can conduct electricity).

- (d) Bronze ($\text{CuZn}(\text{s})$) [will/will not] conduct electricity on its own.

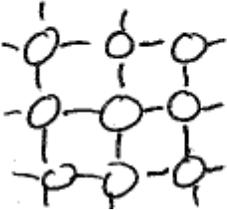
It [will/will not] dissolve in water.

If it dissolves, then the solution [will/will not] conduct electricity. **N/A**

Explanation:

Bronze is made from only metal atoms, so the type of bonding is metallic. The valence electrons are shared in a pool so they are free to flow, which allows them to conduct electricity. Metals do not dissolve in water.

10. Provide a particle drawing to represent the bonding in each of the following substances. Make sure your drawing includes at least 6 representative particles of the substance.

Substance	Drawing
Al(s)	<p>metallic bonding representative particle = atom</p> 
I ₂ (s)	<p>molecular covalent bonding representative particle = molecule</p> 
C(s) (diamond)	<p>network covalent bonding representative particle = atom</p> 
KBr(s)	<p>ionic bonding representative particle = formula unit</p> 

11. **Extension** (optional): Choose a material (e.g., steel, polyethylene, glass, etc.) that is used to make something you use. Research the type of bonding in that substance and write a brief (~300 words max) summary of how the bonding gives it the properties that it needs to do its job. Attach the summary to the problem set.