Alloys - Mixtures of Metals
Bonding Between Metal Atoms

Name_____

PreLAD

Read the introduction and procedure, and do the PreLAD Questions 1-5 on the back of this sheet.

Introduction

Although you use many metallic items in a day such as spoons, jewelry, or the bathroom sink faucet, very few of these substances are pure metals. Rather, most metals you use are actually alloys. Alloys are metallic substances composed of two or more elements, at least one of which is a metal. Alloys are prepared by melting a mixture of the ingredients and then cooling them.

The reason alloys are important is that their properties are often much superior for the particular application compared to the metals that they are made out of. Bronze and brass are made from copper, but are much harder and more durable than pure copper, and more easily cast into molds, making it useful for coins and sculpture. Sterling silver and gold alloys are much harder than the pure silver or gold, but still soft enough to be worked into jewelry. Pure gold is called 24 karat, but is too soft to hold its shape in jewelry, so it is mixed with either silver, copper, or nickel. 18 karat gold contains 18 parts gold, 6 parts other metal. 18 divided by 24 indicates that 18 karat gold is 75 % gold.

The most important alloys today are steels. Different elements such as carbon, boron, chromium, magnesium, molybdenum, nickel, tungsten, and vanadium can be mixed with the main component, iron. These additions to the iron will make it corrosion resistant, harder, more ductile (able to be stretched into wire), tougher, stronger, or easier to cast into molds.

Amalgams are alloys of mercury. They may be liquids or solids. Dental amalgam, used for filling teeth is a liquid when first prepared, but hardens quickly.

In colonial days many mugs and dishes were made of pewter, a mixture of lead and tin.

Cast iron	Fe	96 %
	C	4 %
Stainless steel	Fe	80.6 %
	Cr	18 %
	C	0.4 %
	Ni	1 %
Surgical steel	Fe	67 %
	Cr	18 %
	Ni	12 %
	Mo	3 %
Sterling silver	Ag	92.5 %
	Cu	7.5 %
Pewter	80 % tin	
	20 % lead	
Brass	Cu	90 %
	Zn	10 %
Bronze	Cu	85 %
	Sn	15 %

Procedure

CAUTION: You must wear GOGGLES when you approach the back table, The solution we will be using is a very concentrated sodium hydroxide solution and is very irritating to tissue, particularly eyes. A solution of sodium hydroxide was produced by dissolving solid sodium hydroxide in water. A piece of zinc will be placed into the sodium hydroxide solution, and then warmed on the hot plate near the hood. Do not lean over the pyrex dish and breath in the fumes - they are very strong.

A. Clean off your pennies using the steel wool provided. Please clean the debris of your desk when you are done cleaning, and return the steel wool to the box on the center lab bench.

B. Bring all but one of your shiny pennies to the teacher who will place your pennies onto the zinc plate on bottom of the pyrex dish. The zinc coating will begin to form. The solution will be allowed to GENTLY warm, to speed the formation of the zinc coating. More water will be added to the solution if the solution evaporates too much.

C. After the pennies turn silver colored, the teacher will use the tweezers to remove the pennies, dropping them into your own small beaker of cold water to rinse the sodium hydroxide off and to cool them. Run lots of water into your beaker of water, to rinse off your pennies. Dry them with paper towels.

D. Using the tongs or tweezers, hold one of the pennies as demonstrated in class, put it into the Bunsen burner flame, and turn it evenly until it begins to change to a golden color. (Do NOT overheat the penny, or the golden color will disappear and be turned back to plain copper.) After the color change, QUICKLY drop the hot coin into the beaker water to cool it.

E. Put your pennies on the large white paper on the center lab bench. Circle your pennies with a marker and label them as yours.
   - Your pennies will retain their silver and golden colors, however, the silver penny will revert to copper over time because the zinc coating is so thin and zinc is much more reactive than copper. We may be able to prolong the shininess of the coins by coating them with acrylic spray.

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PreLAD Questions

1. Remember that percent is nothing more than: $\frac{part}{total}$ What is the % of gold in 14 karat gold? Show your calculation

2. As you can see from the list, surgical steel is not pure iron, and it is different than just plain stainless steel? Surgical blades are made out of surgical steel; what do you suppose would be the important characteristics of the surgical steel, that would important for surgical blades? (What characteristics might a surgical blade need that pure iron can not deliver?)

3. Why do you suppose your eating utensils are not made out of pure iron?

4. Why do you suppose it is helpful that dental amalgam is liquid when it is first prepared?

5. Why do you suppose that we no longer use pewter tableware (cups, plates, etc)?

PostLAD Questions

6. Why do you suppose it is important to start with a shiny penny?

7. An alloy forms on the surface of the penny after it is heated to a golden colored. What is the name of this alloy?

8. There are two types of alloys described in your text on page 459. What type of alloy is the alloy that you created in this LAD? Describe how the alloy produced in this LAD is different from the other type of alloy.

9. The silver colored coin is obviously covered with zinc and only turns golden colored after heating it in the Bunsen burner flame. Describe how the heat from the flame allowed the alloy to form?