

# Identification of an Unknown Metal

In this lab we will be using lab techniques and basic chemical concepts to identify an unknown metal. Every metal has a unique set of properties. We will be using density and specific heat (also known as "heat capacity" or "specific heat capacity"). You will also need to use the Internet to determine literature values of specific heat and density. Your objective is to identify the metal assigned to you.

## PROCEDURE - Density

To determine the density of your metal sample, you need to know the mass (in grams), and the volume (in mL = cc = cm<sup>3</sup>). Determine the volume as precisely as possible by measuring water displacement.

## PROCEDURE - Specific Heat

To determine the specific heat of a metal sample, we will use a calorimeter, and the concept of heat transfer; that in a closed system, heat lost by a hot object is gained by a cooler one.

$$S.H._1 \times \text{mass}_1 \times \Delta T_1 = S.H._2 \times \text{mass}_2 \times \Delta T_2 \quad (\text{The Specific Heat of Water is } 4.184 \text{ J/g}^\circ)$$

You will heat a known mass of an unknown metal sample to the same temperature as boiling water by placing a tube of dry metal pellets into a water bath and heating it until the water boils. The water will create a constant temperature environment that will warm the metal. You will need to leave the metal in the water bath at least 10 minutes with the water boiling. Use the temperature probe to measure the temperature of the water bath and to ensure that it is constant. The level of the water bath should be higher than the level of metal in the tube.

You will need to set up a calorimeter with a temperature probe inserted into a known mass of water inside the cup. You will then pour the hot metal into the water and continuously record the change in the temperature of the water/metal system. The hot metal will cause the temperature of the water to increase as the metal cools. This heat exchange will continue until both the metal and the water have reached the same temperature. You will then have all the data you need to determine the specific heat of the unknown metal using the above equation.

**NOTE:** Please perform two complete trials for density determination and for specific heat determination. Use two DIFFERENT samples of the same metal to carry out these procedures. When you have finished using the metal, return it to a drying tray.

## Density

	Trial One	Trial Two	
mass of metal	_____	_____	(g)
volume of water	_____	_____	(mL)
volume of water + metal	_____	_____	(mL)
volume of metal	_____	_____	(mL)
density of metal	_____	_____	(g/mL)

## Specific Heat

	Trial One	Trial Two	
mass of metal sample	_____	_____	
temperature of hot metal	_____	_____	(°C)
mass of empty calorimeter cup	_____	_____	(g)
mass of cup with water	_____	_____	(g)
initial temperature of water	_____	_____	(°C)
final temperature of mixture (metal + water)	_____	_____	(°C)
specific heat of water	<u>4.184</u>	<u>4.184</u>	(J/g°C)
mass of water	_____	_____	(g)
change in water temperature	_____	_____	(°C)
change in metal temperature	_____	_____	(°C)
specific heat of metal	_____	_____	(J/ g°C)

Please be sure to show sample calculations in your laboratory notebook!

Average density of metal: \_\_\_\_\_

Average specific heat of metal (J/g°C): \_\_\_\_\_

Include a few sentences identifying the metal you examined. Describe your metal. Be sure to use full sentences, and compare your experimental values with the "accepted values" for the density and specific heat of your chosen metal. Cite your sources. Wikipedia is not an acceptable source.