**THE DIGITAL BALANCE**

The digital mass balances in the General Chemistry labs are very sensitive instruments used for weighing substances to the milligram (0.001 g) level. Please treat them with care. Use containers when weighing chemicals and always weigh objects at room temperature. Keep the draft shields closed. Do not jar the instruments or change the levels. Always clean the area around the pan with a sable brush after use and inform the stockroom if any liquids or solids spill onto the balance.

![Figure 1: Typical Scales](image)

**How to Use the Balance**

The balance weighing pan is surrounded by a glass draft shield. The doors on the right, left, and top of the shield slide open to allow access to the weighing pan. When weighing objects, close the draft shield doors to prevent changes in air pressure (and measured mass). The front of the balance has a bar and a display window. To turn most balances on, press the bar once and wait a few seconds for the digital display to read "0.000 g". However, some balances require you to press "on/off" and then press the small circle to right of display for the digital display to read 0.000 g.

To weigh an object, slide open one of the draft doors and place the object in the center of the pan. Always use tongs, clamps, or a tissue to handle solid objects or liquid containers. Do not
use your fingers, as oil and water from them initially adds a few milligrams to the mass that then partially evaporates, resulting in an error. Close the door and wait a few seconds for the digital display to read a constant mass. Lighter objects (< 75 g or 200 g, depending on the scale) are weighed to the milligram level (0.001 g). Heavier objects (> 75 g or 200 g, depending on the scale) are weighed to the centigram level (0.01 g). All numbers displayed should be recorded as they indicate the sensitivity of the scale (they are all significant figures). A balance in the "centigram mode" will NOT automatically return to the milligram mode. To reset the balance, press the bar until the display reads "0.000 g". The balance will now measure in the milligram range until a heavy object is again placed on the pan.

Always use a container or weighing paper when weighing a chemical; *do not place any chemical directly onto the balance pan!* Many substances are corrosive and will ruin the sensitive pan and balance mechanisms in just a few minutes. Waxed weighing paper, plastic weighing boats, small beakers, watch glasses, small vials etc. are all convenient containers for weighing chemicals. Additional care must be used when weighing liquids. If possible, flasks containing liquids must be sealed with stoppers to prevent spilling or evaporation during weighing.

*Methods for Weighing*

Two common methods used to weigh a chemical are "weighing by difference" or "taring the balance".

*Weighing by Difference*

*The mass of the chemical is calculated by subtracting the weight of an empty container from the total weight of the container and chemical.* Place an empty container on the pan, close the draft shield doors and wait a few seconds for the display to read a constant mass. Record the mass of the empty container to three decimal places; do not round off. Remove the container from the pan, spoon the chemical into the container, and record the mass of both container and chemical. The mass of the chemical is the difference of the two recorded masses. Remember to handle the container with tongs or tissue; moisture from fingers can cause an error in the apparent mass.
Taring the Balance

The balance is set to ignore the mass of the container so the mass of the added chemical is measured directly. Place the empty container on the pan and close the draft shield. Wait a few seconds for the display to register a constant mass. Press the bar so the display reads "0.000 g". The balance is now set to "ignore" the mass of the container (a process called "taring" the balance). Now if a chemical is added to the container, the balance displays only the mass of that chemical. When the container and chemical is removed from the pan a negative weight will be displayed. (This negative weight is the mass of the original empty container which the balance was instructed to ignore.) To erase this weight from memory, press the bar again. The display should read "0.000g".

Problems

If the displayed mass will not remain constant, make sure all doors of the draft shield are closed. If the mass still does not stabilize, the reason may be one of the following:

- A hot object causes convection currents inside the draft shield resulting in mass fluctuations. Objects must be cooled to room temperature before weighing.
- A solid may be adding or losing weakly bound waters of hydration or may not be completely dry.
- A liquid may be evaporating; cap the container to prevent loss.

Maintenance

Use the sable brush attached to each balance to clean the pan and surrounding area after weighing chemicals. Use paper towels to clean any liquid spills and inform the stockroom immediately so any liquid that has seeped into the balance mechanism beneath the pan can be cleaned.

Handling Chemicals

Avoid contamination when weighing chemicals. Always grasp a chemical container with the label toward the palm of the hand to prevent chemical drips (from the lip of the container) obscuring the label and safety information. If all students practice this habit, only one side of the bottle is contaminated with "drips" and the other side is always safe to handle. Pour out a small amount of the chemical into a clean beaker first and use a clean spatula to transfer the chemical
from beaker to weighing container. If any chemical in the beaker is not used, it should be placed in the collection receptacle for solids in the hood. (The chemical will be used when purity is not a necessity.) Never pour a chemical back into a reagent bottle. This practice ensures the purity and integrity of the chemical in the original container.

**Review Questions:**

- What is the meaning of "taring the balance"?
- What is the meaning of "weighing by difference"?
- How many decimal places should be used when weighing an object < 75 g?
- On the Mettler balances, how many decimal places are displayed for objects > 75g?
- What should you check if the display does not give a constant mass value?
- Do you think an error will result if a student performs a series of sequential weighings but uses a different balance each time?
- A student places an object on a balance that is initially reading 0.000 g and the object weighs 5.227 g. He presses the space bar and the balance reads 0.000 g again. He then removes the object. What does the display read?
- What is the proper method for handling a chemical container?
- What should be done with excess chemicals left over from a weighing procedure?