

# EXPERIMENT 3: Weighing

## INTRODUCTION

### A. The Top-Loading Balance

The top-loading balance digitally displays a mass reading, in grams, to 2 decimal places. The uncertainty in a single reading on the top-loading balance is  $\pm 0.05$  g. Top-loading balances are located inside the lab room.

### B. The Analytical Balance

The analytical balance is more accurate than the top-loading balance. Its digital display gives mass, in grams, to 4 places after the decimal. The uncertainty in a single reading on the analytical balance is  $\pm 0.0002$  g. You will use this balance if the experiment calls for accurate measurement of mass. Never use the analytical balance if the top-loading balance will do. The analytical balances are located in the "BALANCE room" adjacent to the laboratory.

### C. RULES FOR WEIGHING:

1. Do not handle objects to be weighed with bare hands. Use tongs, or paper towels if no appropriate tongs are available.
2. Never weigh chemicals directly on the balance pan; use a glass container or weighing paper or filter paper.
3. If you spill a chemical on the top-loading balance, clean it immediately. Never spill chemicals inside the analytical balance enclosure. Keep the weighing chamber and weighing pan clean.
4. Before using the balance, be sure that the pan is clean. If it is dirty report it to your instructor, then brush it off with the brush provided.
5. Do not overload the balance. The maximum capacity of the top-loading balance is 620 g. The maximum capacity for the analytical balance is 110 g.
6. Do not weigh hot or cold objects on the balance. Hot objects will give erroneously low readings due to buoyancy of hot air, while cold objects will give high readings.
7. Check to be sure that the balance is level. It is level if the bubble in the Level Indicator is in the center while the balance is "OFF". Your instructor may need to adjust the Leveling Feet.

### D. WEIGHING BY DIFFERENCE TO OVERCOME THE PROBLEM OF BALANCE CALIBRATION ERRORS.

How accurate are your balance readings? There is no way for you to know. In order to overcome the problem of inaccurate readings due to lack of calibration or miscalibration, chemists designed a method called weighing by difference. It does not matter how far off each reading of your balance is if you weigh your sample by difference.

Example: Weighing a solid sample by difference from a beaker: To find the mass of the sample in the beaker, first the empty beaker is placed on the balance and the mass is read. Then the solid is added to the beaker and the mass of beaker with solid is read. The mass of the solid sample is the difference between the two readings.

1. Using Balance 1, a calibrated balance, the following masses are recorded:

Mass of Empty Beaker	24.7423 g
Mass of Beaker + Solid	26.7587 g
Mass of sample:	$26.7587\text{g} - 24.7423\text{ g} = \underline{2.0164\text{ g}}$

2. Using Balance 2, an uncalibrated balance (all readings are low by 0.5000 g) the following masses are recorded:

Mass of Empty Beaker	24.2423 g
Mass of Beaker + Solid:	26.2587 g
Mass of sample:	$26.2587\text{g} - 24.2423\text{ g} = \underline{2.0164\text{ g}}$

Does it matter which balance, 1 or 2, you choose to use? \_\_\_\_\_

Explain:

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## EXPERIMENT

Throughout the weighing process you should protect the object you are weighing from coming in contact with your hands by handling it with a paper towel.

### A. THE TOP-LOADING BALANCE

1. Get a numbered metal block from the side bench. Record its number on the Report Sheet.
2. Locate the top-loading balances in your lab.
3. Check the balance for dust or chemicals, brushing off any that you see.
4. Check the balance level. Look for the Level Indicator at the back of the balance. The bubble should be in the center of the circle. If it is not, ask your instructor to level the balance for you. Students should not attempt to adjust the level themselves.
5. Turn the balance ON. Wait until it displays "0.00 g", then place your metal block on the pan. Read the balance and record the mass directly onto your Report Sheet. (USE INK!) Remember, if you record a datum incorrectly on your report sheet, just cross it out with a single line and write the correct value next to or above it.
6. Turn off the balance. Please always remember to turn off the top-loading balance when finished.
7. Using the same metallic block, repeat steps 2-6 using two other top-loading balances.

### B. THE ANALYTICAL BALANCE

1. Get a numbered metal block from the side bench. Record its number on the Report Sheet.
2. Locate the analytical balances in your lab. They're in the weighing room adjacent to the lab.

Notice that the weighing pan of the analytical balance is enclosed in glass. This glass case is designed to protect the balance from temperature fluctuations and air currents that cause the balance to drift—that is, the digital display continues to change in one direction (up or down). To make sure that the temperature of the air in the balance does not change, keep your hands (which are warmer than the air in the balance) out of the enclosure as much as possible, and keep the balance doors closed.

3. Check the balance for dust or chemicals, brushing off any that you see.
4. Check the balance level. Look down through the glass top to the floor of the balance. The leveling bubble is visible through a hole in the floor. If the bubble is not centered, ask your instructor to level the balance for you. Students should not attempt to adjust the level themselves.
5. Push the ON button. Allow the balance to calibrate. After about 5 seconds, it will display "0 .0000 g". The balance is now ready to be used. If the balance does not read zero, push the T (tare) button. The balance should read 0.0000 g.
6. Slide open the door and carefully place the metal block on the center of the pan to avoid corner load errors.
7. Close the balance door and after about 5 seconds read and record the mass of the metal block on your Report Sheet. (Remember: all data must be recorded in INK.)
8. Carefully remove the object and close the door, then push the "OFF" button.
9. Repeat steps 2 to 8 using two other different analytical balances to find the mass of the same metal block. Record your data on your Report Sheet.

C. WEIGHING BY DIFFERENCE USING THE TARE FUNCTION OF THE ANALYTICAL BALANCE.

1. Clean the outsides of three 125 ml Erlenmeyer flasks. Make sure the Erlenmeyer flasks are completely dry on the outside. Label the flasks: 1, 2, and 3 by writing the numbers on the white patches on the flasks.

Reminder: Throughout the weighing process you should protect the Erlenmeyer flasks from your hands with a paper towel.

2. Take the following items with you to the weighing room: Erlenmeyer flask #1, Report Sheet, pen.
3. Turn the analytical balance on and allow it to calibrate.
4. Once it reads 0.0000g, place flask #1 on the balance pan and close the balance door.
5. Push the T (tare) button and the display will read 0.0000g, even though the flask is on the balance pan. Report this reading as the Initial reading on your report sheet.
6. There is some NaCl in a plastic weighing boat next to the analytical balance. Use the long-handled plastic spoon provided to carefully transfer, without spilling, a small amount of NaCl into flask #1. Tap the handle of the spoon with your finger to get it to fall out of the spoon. Continue to add NaCl a little at a time until the display reads approximately 0.3 g. Close the balance door and record the reading on your Report Sheet. Remember that the analytical balance reads and should be reported to 4 decimal places.
7. When you are finished, remove the Erlenmeyer flask, close the balance door, touch the tare bar then turn the balance off.
8. Repeat steps 1 through 7, weighing samples of about 0.3 g into each of the remaining flasks, #2 and #3.
9. Wash your Erlenmeyer flasks (do a final rinse with deionized water) and store them for your next lab period.



REPORT SHEET  
EXPERIMENT 3: Weighing

Name \_\_\_\_\_

Instructor's initials \_\_\_\_\_

DATA:

A. TOP-LOADING BALANCE

Metal block # \_\_\_\_\_

Readings: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Instructor's initials \_\_\_\_\_

B. ANALYTICAL BALANCE

Readings: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Instructor's initials \_\_\_\_\_

C. WEIGHING BY DIFFERENCE USING THE ANALYTICAL BALANCE.

	Sample #1	Sample #2	Sample #3
Initial reading			
Final reading			
Calculated mass of NaCl sample			

Instructor's initials \_\_\_\_\_

## QUESTIONS:

1. If you weigh an object whose mass is about 13 g, how many significant figures will there be in its mass if you weigh it on the top-loading balance?  
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2. If a procedure tells you weigh the sample accurately, which balance would you use, the analytical or the top-loading balance?  
\_\_\_\_\_
3. An analytical reads to 0.1 milligram. How many grams is that?  
\_\_\_\_\_
4. If a procedure tells you to "Add about 3 g of ammonium sulfate" which balance would you use, the analytical or the top-loading balance?  
\_\_\_\_\_
5. If a procedure tells you to "Weigh to the nearest tenth of a gram about 3 grams," which balance would you use, the analytical or the top-loading balance?  
\_\_\_\_\_
6. If a procedure says "Weigh accurately about 0.8 g", which balance would you use, the analytical or the top-loading?  
\_\_\_\_\_
7. The vessel to be weighed should be placed (off to the side, or in the center) of the balance pan.  
\_\_\_\_\_
8. After heating a sample in a dish should you weigh it immediately to save time or should you allow it to cool completely before weighing it?  
\_\_\_\_\_
9. During the same experiment, one must be careful to always use (the same, different) balance.  
\_\_\_\_\_
10. To avoid the errors in mass due to the use of balances that are not calibrated, one should weigh by a method called...  
\_\_\_\_\_
11. If you weigh a hot object on the balance, will the reading be higher, the same, or lower than it will be after it cools to room temperature?  
\_\_\_\_\_
12. If you weigh a cold object on the balance, will the reading be higher, the same, or lower than it will be after it warms up to room temperature?  
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