ANALYTICAL BALANCE

An analytical balance, often referred to as a “lab balance” are designed for measuring mass with a high degree of accuracy with readabilities ranging from 0.01mg (semi-micro) to 0.0001g. Designed for precise weighing of small samples, analytical balances are used in a range of industries such as science laboratories, pharmaceuticals research and development and higher education institutions.

Analytical balances are sensitive and expensive instruments.

FEATURES:

- Staring gauge technology
- Stainless steel pan
- Backlit LCD display
- Plastic draft shield

- Height-adjustable feet
- Taring
- Four different units of measure: g, lb, ct, oz
- Piece counting function

PANEL DESCRIPTION:

1. ON/OFF: Turns device on and off
2. UNIT: Select between ct, oz, lb, g
3. PCS: Piece counting mode
4. CAL: Calibration key
5. TARE/ZERO: Tare the balance

BEST LOCATION FOR AN ANALYTICAL BALANCE:

1. These sensitive devices are easily affected by air currents, temperature and other physical variables, so they are enclosed or shielded to reduce exposure. Still, the enclosures will not be able to protect them completely.

2. You need to ensure they're placed in a secure location that is quiet, clean, temperature-controlled and draft-free.
3. If the building floor isn't level, the analytical scale should be placed near an outside wall to reduce misalignment issues.
4. They should be placed on a sturdy and level weighing table, with a cork or rubber layer to absorb vibrations.
5. For higher accuracy and readability, use a balance with a self-correct feature or additional filters against physical influences.

CONSTRUCTION AND WORKING OF ANALYTICAL BALANCE

PRINCIPLES OF ANALYTICAL BALANCE:

- Modern electronic laboratory balances work on the principle of magnetic force restoration.
- In this system, the force exerted by the object being weighed is lifted by an electromagnet.
- A detector measures the current required to oppose the downward motion of the weight in the magnetic field.

FUNCTION OF ANALYTICAL BALANCE:

- Analytical balances are highly sensitive lab instruments designed to accurately measure mass.
- Their readability has a range between 0.1mg - 0.01mg.
- Analytical balances have a draft shield or weighing chamber to prevent the very small samples from being affected by air currents.

HOW AN ELECTRONIC BALANCE WORKS?

- An electronic balance is the most common method for determining a sample's mass.
- An electromagnet levitates the balance's sample pan above a permanent cylindrical magnet.
- The amount of light reaching a photodetector indicates the sample pan's position.
- The amount of light reaching the detector in the absence of a sample defines the balance's null point.
- Placing an object on the balance displaces the sample pan downward by a force equal to the product of the sample's mass and its acceleration due to gravity.
- The balance detects this downward movement and generates a counterbalancing force by increasing the current to the electromagnet.
- The current returning the balance to its null point is proportional to the object's mass.

USING AN ANALYTICAL BALANCE:

Preparing the balance for use:

- The first step is to prepare the balance for weighing your sample, by leveling and zeroing it.
- Check whether the leveling bubble on the weighing chamber's floor is centred or adjust the levelling screws located underneath.
- Then, close the chamber doors and briefly press down on the control bar till a row of zeros is displayed.
- Solid objects can be weighed directly on the balance pan, by opening the Weighing a solid object directly on the balance

- If the object you need to weigh is a solid object, you can weigh it directly on the pan. Be sure the balance is zeroed. Open the chamber doors, carefully place the object on the balance pan, close the doors, and read the mass of your object. doors and placing the object on the pan.
- The readout will be displayed after you close the doors.
- Use the appropriate container for weighing liquids, powders, or granular substances.
- Start by placing the container on the pan and zeroing the balance. Then, carefully add the sample (either directly, or by removing the container and making sure the control bar is untouched), close the doors and check the readout.
- If any chemicals have spilled on the balance, it should be cleaned thoroughly.
- Shut it down (by gently raising the control bar) after you're done using with your weighing procedures for the day.

GENERAL RULES FOR WEIGHING:

1. Never handle objects to be weighed with the fingers. A piece of clean paper or tongs should be used.
2. Weigh at room temperature, and thereby avoid air convection currents.
3. Never place chemicals directly on the pan, but weigh them in a vessel (weighing bottle, weighing dish) or on powder paper. Always brush spilled chemicals off immediately with a soft brush.
4. Always close the balance case door before making the weighing. Air currents will cause the balance to be unsteady.

WEIGHING A LIQUID, POWDER, OR GRANULAR SUBSTANCE:

- These substances must always be weighed using an appropriate weighing container.

- Place the weighing container on the balance pan and close the doors.
- Tare the container by briefly pressing the control bar. The readout will read zero with the container sitting on the pan. This allows the mass of your sample to be read directly.
- Add the substance to be weighed. Be careful not to spill chemicals on the balance. If need be, you can remove the container from the weighing chamber while you add the sample provided that no one presses the control bar before you weigh your sample.
- With the sample and its container sitting on the pan, close the chamber doors and read the display to find the mass of your sample.

WEIGHING A SOLID OBJECT:

- If the object you need to weigh is a solid object, you can weigh it directly on the pan. Be sure the balance is zeroed.
- Open the chamber doors, carefully place the object on the balance pan, close the doors, and read the mass of your object.

VOLUMETRIC GLASSWARE

(Tools Used to Measure the Volume of a Liquid)

In the sciences, the “tools” for measuring the volumes of liquids are generally made from glass, plastic or occasionally metal, although professionals referred to all of them as “glassware.” Scientists, and chemists in particular, have a variety of glassware at their disposal for measuring volumes. The particular piece of glassware chosen in any situation will depend primarily upon two factors: the required volume and the accuracy required for the measurement.

Graduated cylinders, beakers, volumetric pipets, burets and volumetric flasks are five kinds of glassware often used to measure out specific volumes. Volumetric pipets, flasks and burets are the most accurate; the glassware makers calibrate these to a high level of accuracy. The accuracy is usually measured in terms of the tolerance, which is the uncertainty in a measurement made with the glassware.

- **Beakers and Flasks**

Beaker

Erlenmeyer Flask

Beakers and Erlenmeyer flasks can be used to make coarse measurements of volumes, provided that graduated volume levels are printed on the side of the beaker or flask (not all beakers and flasks have these marks). They are usually accurate to within 5%. The volumetric flask, designed for greater precision, is typically accurate to within 0.05%. Its uses include the preparation of solutions of known concentration.

Types of Beakers

Beakers are the standard vessel used in chemistry. They come in all sizes including 5 millilitre (ml) flasks and flasks of many litres (L). Much like a cup

or a mug, they consist of a cylinder, usually glass, with a flat bottom made to hold liquid. Beakers may or may not have a pour spout although they usually do. They also may or may not have markings on the side labelling the approximate volume they contain. They are not very precise in their measurement and are made to contain chemicals or reactions. If a beaker needs to be heated, a hot plate is ideal, but a Bunsen burner and beaker holder will also work. Although most types of beakers are made of glass, plastic beakers are also available.

1. **Erlenmeyer Flasks**

   Erlenmeyer flasks are flat-bottomed flasks that are similar to beakers, except that the sides taper in as they go up and form a narrow vertical neck. They also typically have measurement markings and pour spouts. They are typically used when chemicals need to be heated because their tapered sides help keep some of the heat in that might otherwise be carried away by evaporating materials. They can be heated over a Bunsen burner or a hot plate.

2. **Round Bottom Flasks**

   Round bottom or boiling flasks do not stand up on their own and must always be held by a clamp. They typically do not have markings (other than a mark approximating maximum volume) or pour spouts. They can be heated by Bunsen burner, or by a special type of hot plate that is made to accommodate the round bottom.

3. **Volumetric Flasks**

   Volumetric flasks are a very precisely made type of science flask. They are made to measure out extremely accurate volumes of liquid. They typically

have a bulbous bottom that may or may not be flat, and a very long, very narrow neck. A marking on the neck is there for measurement. When the meniscus of the liquid in the flask is level with this mark, a precise volume has been measured. The flask will also be labelled with the error margin for the measurement. These flasks may change volume if subjected to high heat, so must be air-dried and should not be heated.

4. **Filtering Flasks**

Filtering flasks are shaped much like an Erlenmeyer flask with a short side tube. These flasks are used with a Buchner funnel (a ceramic funnel) and a vacuum pump system. The vacuum pump is attached to the side tube in the flask. Filter paper is fitted into the Buchner funnel and the material to be filtered added to the funnel. As the vacuum pump creates a low-pressure system in the flask, liquid is drawn through the filter paper into the flask.

5. **Distillation Flasks**

Distillation flasks, also called fractional distillation or fractioning flasks, resemble round bottom flasks with a long side arm or tube projecting from the neck of the flask. These flasks are used to separate fluids based on their boiling and condensation temperatures.

- **Graduated Cylinders**

Graduated cylinders are transparent cylinders with finely divided markings – otherwise known as graduations – marked on their side. They represent a significant improvement in accuracy over beakers and flasks – generally to within 1%. Thus, a 10 mL graduated cylinder will be accurate to within 0.1 mL. Graduated cylinders are manufactured in sizes ranging from 5 mL to 2000 mL. As with beakers and flasks, graduated cylinders are available in

either glass or plastic; glass is easier to clean, but more fragile and expensive than plastic.

- **Burettes**

To a scientist, a large difference exists between a volume of 25 millilitres (mL) and 25.00 mL. The first quantity only requires a precision of 0.5 mL; that is, the measuring device only needs to be able to measure an actual volume that's within a few tenths of 1 mL. Measuring 25.00 mL, however,

requires a device capable of measuring to within a few one-hundredths of a millilitre. Glassware with such accuracy is categorized as “volumetric” glassware. Burets fall into this category.

Burets (burette) are also cylindrical pieces of glassware with graduations painted on the side, but they have a valve at the bottom (called a “stopcock”) that allows the liquid to flow out the bottom. They are typically accurate to within 0.01 mL. Burets are available in sizes from 10 mL to 100 mL, although 50 mL is the most common size.

There are two main types of burette; the volumetric burette and the Piston burette or Digital burette. A volumetric burette delivers measured volumes of liquid. Piston burettes are similar to syringes, but with a precision bore and a plunger

- **Pipets**

Pipets are slender tubes, typically 12 to 24 inches long. They may measure a predetermined volume such as 25.00 mL or 10.00 mL. They may also have graduations (these are called “Mohr” pipets) that allow odd and fractional volumes to be delivered. They are generally accurate to within 0.02 mL and are thus classified as volumetric glassware. When you squeeze the rubber

bulb on the pipet, the suction from the expanding bulb draws liquid into the pipet. The operating principle is much the same as sucking liquid through a straw, but without the hazard of requiring mouth-to-glassware contact, which is strictly prohibited in laboratories. Some pipets are single-use devices made of disposable plastic.

A pipette is a small tube that can transfer liquids from one container to another. Pipettes, or pipets, are common pieces of laboratory equipment.

Types of Pipettes

Pipettes may be constructed out of glass or plastic and are used to transfer a measurable amount of liquid.

1. **Volumetric Pipettes**

Volumetric pipettes transfer a single, predetermined volume of liquid. They are often called a bulb pipette for their shape, which is a long tube-like shaft at the bottom and top and a bulb in the centre where the bulk of solution is held. The name is also indicative of the bulb that attaches to the top of the pipette, often made of rubber, which must be manually squeezed to create a vacuum.

As the rubber bulb begins to fill with air, a solution is drawn into the pipette. While seeming rudimentary, volumetric pipettes are extremely precise (up to four significant figures). They are limited to the particular amount calibrated and cannot be used to accurately measure liquid amounts less than their specified capacity.

2. **Measuring Pipettes and Micropipettes**

Measuring pipettes have graduated volumes, like a graduated cylinder, and can dispense different volumes. Measuring pipettes are calibrated with small divisions and are often adjustable, allowing users to accurately draw up the necessary amount of liquid.

Micropipettes are accurate and precise and can transfer measured volumes of microliters of volume. Micropipettes are spring-loaded instruments and require calibration every few months either from the manufacturer or by a process of weighing water at a known temperature.

3. Pasteur Pipette

Pasteur pipettes, named for Louis Pasteur, are similar to eye droppers and can transfer a small amount of liquid. They are made of glass or plastic, have a separate bulb and are not graduated for a certain volume.

4. Transfer pipettes

Similar to Pasteur pipettes, they are made of plastic but melded, so the bulb may contain some of the liquid. Squeezing the bulb will create a vacuum and liquid may be drawn up.