Analytical Tools

Analytical Balances

An modern analytical balance uses a magnetic force to balance the pan and determine the mass of the sample (Figure 2-3)

Analytical balances can measure to a precision of 0.0001 g (0.1 mg)

Precaution to use when weighing

- Do not touch sample or container with fingers —the balance is precise enough to weigh finger prints

Analytical Balances

Precaution to use when weighing

- Close the doors on the balance to prevent air drafts from affecting results
- Correction for buoyancy—upward force by air under pan of balance

$$m = \frac{m'\left(1 - \frac{d_a}{d_w}\right)}{\left(1 - \frac{d_a}{d_s}\right)}$$

m = true mass of object
m' = mass reading from balance
d_a = density of air
d_w = density of weights (8.0 g/mL)
d_s = density of sample

Analytical Balances

Buoyancy Correction

Determine true mass of a $CuSO_4 \cdot 5H_2O$ sample with a mass reading of 0.5672 g

d_s = 2.284 g/mL d_w = 8.0 g/mL

$d_a = (P \cdot MW)/(RT)$

= (1 atm)(29 g/mol)/(.08205 Latm/molK)(298K) = 1.186 g/L

= 1.19 x 10^{-3} g/mL

$$m = \frac{0.5672\ g\left(1 - \frac{1.19 \times 10^{-3}\ g/mL}{8.0\ g/mL}\right)}{\left(1 - \frac{1.19 \times 10^{-3}\ g/mL}{2.284\ g/mL}\right)} = 0.5668\ g$$

Burets

Burets are used to precisely measure the volume of a liquid, usually when performing a titration

The liquid in a buret will always form a meniscus, usually concave (higher on the sides than in the middle)

- It is customary to read the bottom of the meniscus
- Parallax—a false reading when your eye is not at the same level as the meniscus

Burets

Precautions for use of burets

- Run some liquid through the tip to remove all air bubbles before making measurements
- Clean your buret so the liquid drains completely from the walls, leaving no drops
- Near the endpoint, spin the stopcock quickly to deliver a fraction of a drop
- You can read a 50 mL buret to 0.01 mL precision

Pipets

Pipets come in several flavors:

- Volumetric
- Graduated
- Micropipets

When using a rubber bulb with a pipet, ***do not*** place the end of the pipet in the stem of the bulb—use the bulb simply to fill the pipet, and then use your thumb to drain to the desired volume

Calibration of Volumetric Glassware

For the most accurate results possible, volumetric glassware should be calibrated

This is done by filling the glassware to the mark with distilled water at a known temperature, draining the water into a flask of known mass, and weighing the water and flask to determine the mass of water

Volume is then determined using the density of water at the specified temperature

Calibration of Volumetric Glassware

Example

Your 100 mL volumetric flask weighs 26.3428 g when cleaned and dried. You then add water to the mark, and the flask with water weighs 125.3149 g with T = 22.0 ^{o}C. Determine the volume of your flask.

m_{H2O} = 125.3149 – 26.3428 = 98.9721 g

d_{H2O}(22.0 ^{o}C) = 0.997774 g/mL

V_{flask} = (98.9721 g)/(.997774 g/mL) = 99.193 mL