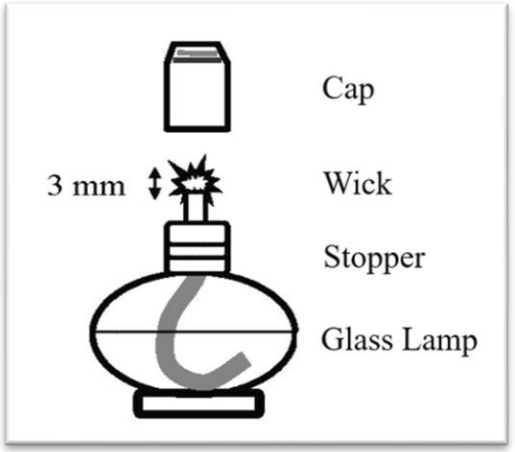
General Chemistry Laboratory

Operation Guides for Common Lab Instruments and Techniques

Last revised: 2022/9/5

T1 – Alcohol Burner

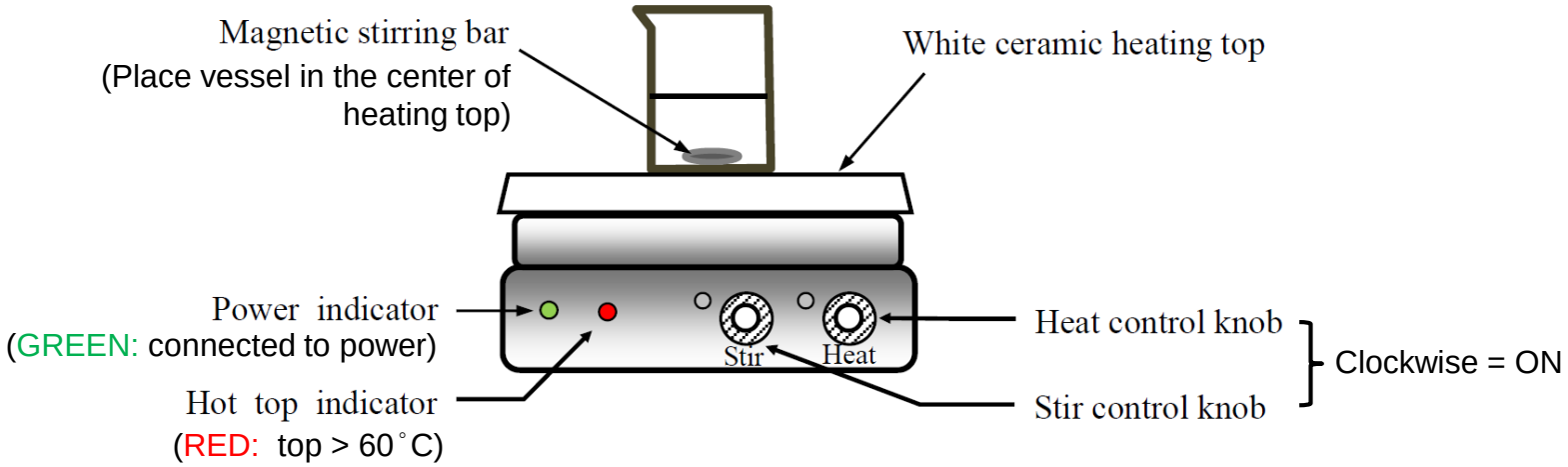
- Inspect the burner before use – make sure that there are no cracks, chips or defects in the glass body
- Adjust the wick length to ~ 3 mm from the top of the stopper
- Fill with denatured (or 95%) ethanol through a funnel to 1/2 - 2/3 full
- Use a match to light the wick of the burner (do NOT use a burner to light another burner)



- When in use, keep the burner in an upright position and away from combustible materials (e.g. paper, clothing, etc.)
- If necessary, use a metallic windshield (not papers or books) to block wind
- Do not use books or other items to raise the height of alcohol burner (adjust the height of the heated object instead)
- Use the cap to put out the flame (do not blow off the flame)
- If the burner is overturned and causes a small fire, cover the fire quickly with a wet rag (do not remove the rag right away or flame may reignite). In the case of bigger fire, use a fire extinguisher instead. Inform lab instructor ASAP after the fire is put out, and open the windows to disperse the alcohol vapor

T1 Video (YouTube link)

T2 – Stirrer/Hot Plate



- Connect the stirre/hot plate to a grounded 110 V power outlet (replace damaged power cord and plug immediately)
- Keep power cord away from the ceramic heating top
- Clean the heating top with non-corrosive detergent after use or when liquid spills
- NEVER heat a large amount of volatile and flammable liquid (e.g. ether, acetone) directly on the hot plate
- If the stirring bar jumps erratically, turn the stirring function off and adjust the vessel position, then restart the stirring
- Do not remove the stirring bar from solution with hand – instead use a Teflon-coated magnetic rod (“fishing pole”)

T2 Video (YouTube link)

T3.1 – Mercury Barometer

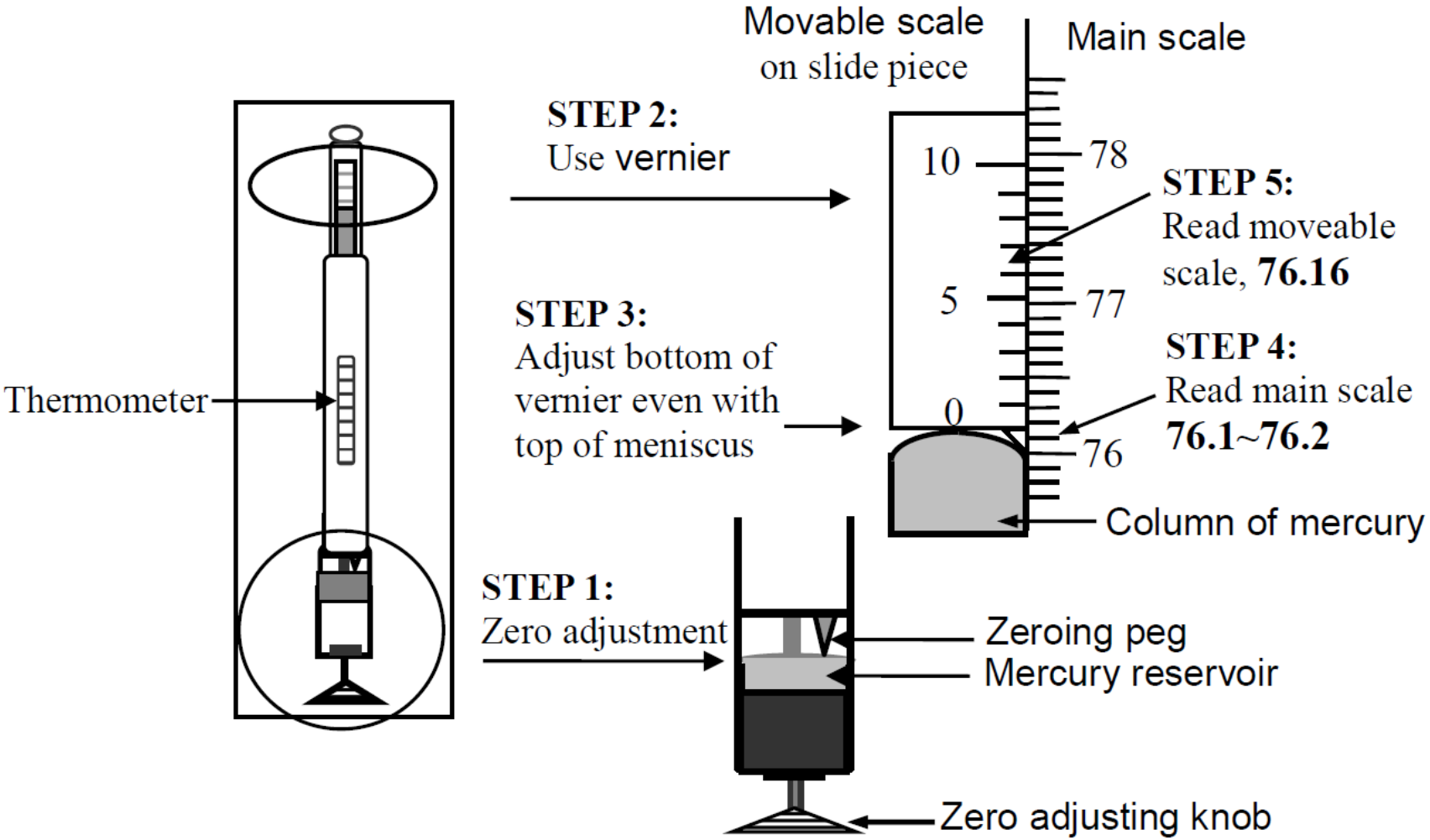


Figure T3-1 Illustration of mercury barometer

T3 Video (YouTube link)

T3.2 – Mercury Barometer

- Zero adjustment: Rotate the **Zero Adjustment Knob** at the bottom of barometer to align the tip of **Zeroing Peg** with the top of mercury reservoir
- Read the mercury column height with a **Vernier Scale**:
  1. Adjust the **Slide Piece** so that its bottom is even with the top of mercury meniscus
  2. Read the main scale on the right: In Figure T3-1, the bottom of the slide piece indicates the height of mercury column is between 76.1 and 76.2 cm
  3. Read the movable scale on the left: The percentile of measurement is given by the line that aligns with the mark on the main scale. This value is 6 in Figure T3-1, therefore the measured atmospheric pressure is 76.16 cm-Hg
- For more precise measurement, one should make temperature correction (refer to the manual of barometer)

T3 Video (YouTube link)

T4 – Collecting Gas Over Water

- This technique is used to collect water-insoluble or slightly water-soluble gases (e.g. hydrogen H_2, oxygen O_2, and nitrogen N_2)
- Water-soluble gases such as NH_3, HCl are not suitable to be collected by this method
- Because the density of gas is lower than that of water, when the gas is introduced into the collection device (test tube in Figure T4-1) water will be displaced out

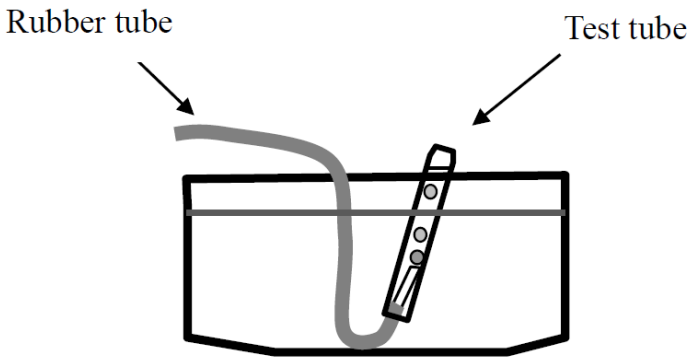


Figure T4-1 Collection gases over water

- Operation:
  1. Fill a test tube with water and immerse it in a water basin (the open end points down)
  2. Place the rubber tube into the open end of the test tube
  3. When gas bubbles start to emerge from the open end of test tube, remove the rubber tube
  4. Place the test tube upside-down on the lab bench, or seal it with a rubber stopper

T4 Video (YouTube link)

T5 – Decantation

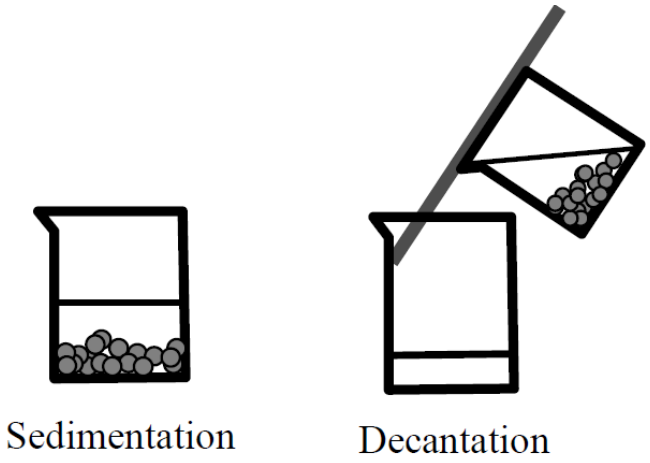
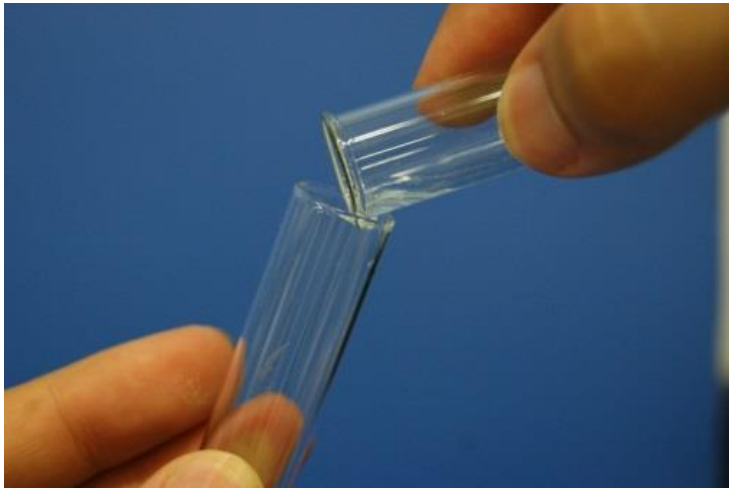


Figure T5-1 Sedimentation and decantation



Decantation between two centrifuge tubes

Decantation is a simple method for separting solid from liquid. The solid precipitate settles to the bottom if its specific gravity is greater than that of liquid. While there may still be some solid remaining suspended in the liquid, the separation can be achieved by carefully pouring the liquid off:

- Let the solid settle to the bottom of the mixture (or use a centrifuge – see T8)
- Pour the liquid out of beaker and use a glass rod to guide the liquid flow (Figure T5-1). This must be done slowly so that no solid is carried over.

T5 Video (YouTube link)

T6 – Gravity Filtration

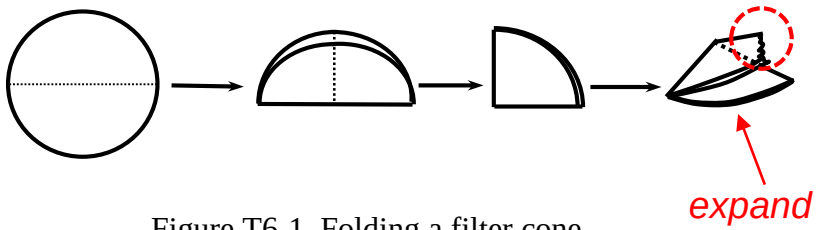


Figure T6-1 Folding a filter cone

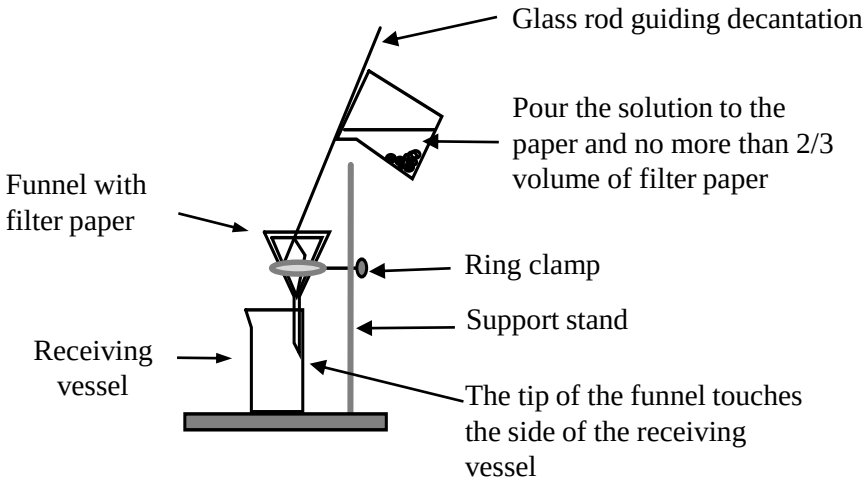


Figure T6-2 Setup of gravity filtration

- Fold a round filter paper in half for two times. Tear off a small piece at one of the two thin outside corners
- Expand the filter paper (from the intact fold) into a cone shape. Fit the filter paper into a funnel (the edge of filter paper should not exceed the top of funnel)
- Use a ring clamp to support the glass funnel. The tip of the funnel should touch the sidewall of the receiving vessel
- Pour the liquid into the paper cone (not on the glass funnel). Use a glass rod to decant the liquid
- Fill the paper cone no more than 2/3 full
- After filtration, use a tweezer to separate the filter paper from funnel (don't use hand)

T6 Video (YouTube link)

T7 – Vacuum (Suction) Filtration

- Fill the tank of water aspirator with tap water (bottom in, top out) and maintain a slow overflow rate
- Fix both the safety trap (buffer flask) and the suction flask with extension clamps
- Install a Büchner (or Hirsch) funnel on the suction flask. Use a rubber stopper or a rubber gasket cone to seal the flask

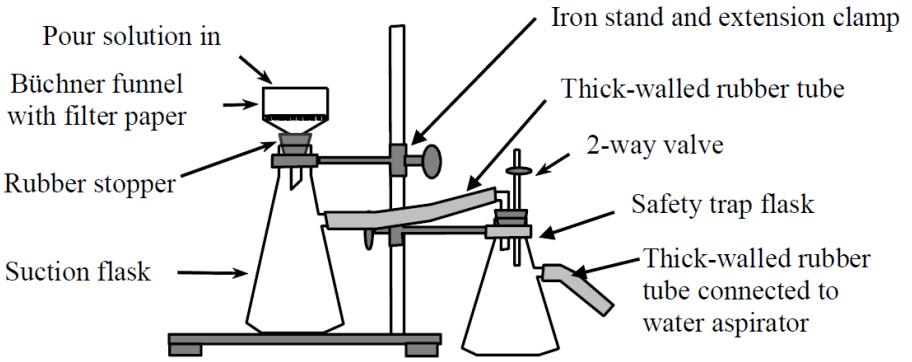


Figure T7-1 Setup of vacuum filtration

- Cover the perforations of funnel with an unfolded circular filter paper of suitable size
- Moisten the filter paper with a small amount of solvent. Switch on the water aspirator and close the 2-way valve on the safety trap (stopcock in horizontal position)
- Pour the solution onto the filter paper. Wash the precipitate with a small amount of solvent or wash liquid. Let the precipitate air-dry for ~ 5 minutes.
- Open the 2-way valve on the safety trap (stopcock in vertical position). Switch the water aspirator off if no one else is using it.
- Turn the water flow off and empty the water aspirator tank

T7 Video (YouTube link)

T8 – Centrifugation

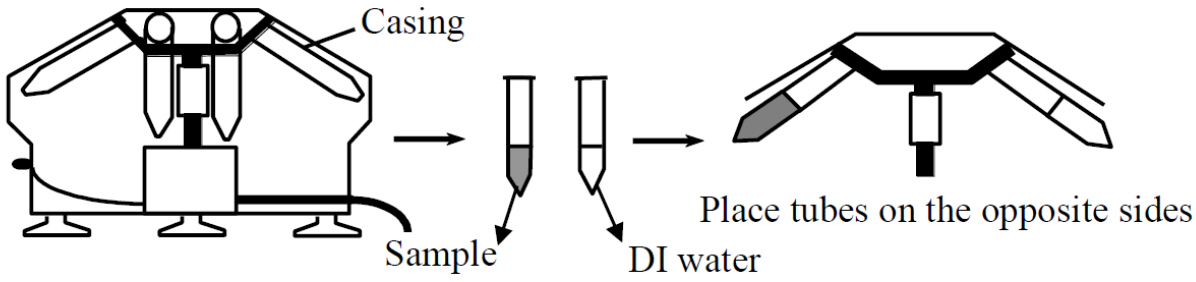


Figure T8-1 Section view of a centrifuge

T8 Video (YouTube link)

- Inspect whether the casings are still intact; clean or replace the casings if necessary
- Do NOT use regular test tubes in centrifuge; use only designated centrifuge tubes
- Mind the balance of the setup; only work with even number of tubes at the same time, and place them directly opposite to each other
- If only one sample solution needs to be centrifuged, take another tube with a similar amount of DI water and place it at the counterbalancing position
- Close the cover before starting the motor. Start the motor from low speed, then ramp up the speed if no malfunction is detected
- In cases of unusual sound or vibration occurring, turn the centrifuge off immediately
- Allow the rotating assembly to deaccelerate on its own after the process. Do NOT attempt to stop it manually, and open the cover only after the assembly has stopped

T9 – Electronic Balance

- Unless instructed, do not move the balance so that proper calibration is maintained
- Do not overload the balance (the maximum load is 610 grams for *electronic balance*, and 210 grams for *analytical balance*)
- Before use, warm up the balance for at least 30 min and ensure that it is level and clean

Electronic Balance
(resolution 0.01 g)

Analytical Balance
(resolution 0.0001 g)

- Do not put chemicals directly on the weighing pan – use a folded weighing paper, a weighing boat, or a beaker (mind the weight limit) as container
- Close all windshields on the *analytical balance* before zeroing and recording values
- Maintain the tidiness inside and outside the balance; use the provided soft brush to clean spillages
- Do not weigh hot objects as the convective airflow will affect the measured mass

T9 Video (YouTube link)

T10 – Weighing Chemicals

- Read the label on the chemical bottle carefully before proceeding to weigh
- For solid chemicals, place a folded weighing paper or a beaker on the electronic balance to hold chemicals. Use a clean and dry spatula to move chemicals
- For liquid chemicals, use a clean and rinsed dropper pipet

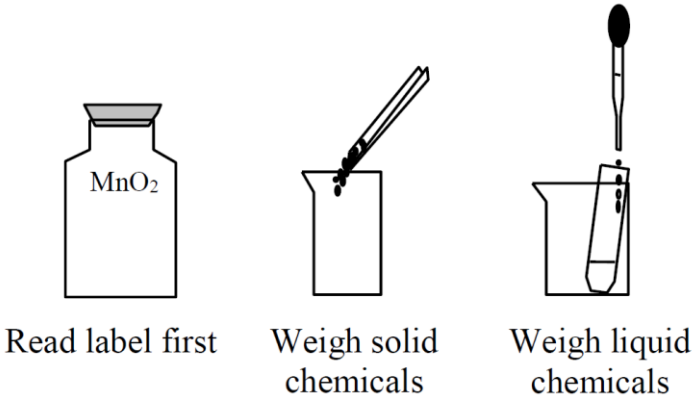


Figure T10-1 Weighing chemicals

- Unless specifically instructed, never return any excess chemical to the original bottle to avoid contamination – use the designated waste bin
- Maintain the tidiness inside and outside the balance – move appropriate amount with spatula to avoid any spillage, and use the provided soft brush to clean scattered chemicals
- Close the cap of chemical bottle immediately after use

T10 Video (YouTube link)

T11 – Graduated Cylinder

- Clean the graduated cylinder and rinse it twice with small amount of the liquid to be measured
- Carefully add the liquid to be measured into the graduated cylinder against the inner wall
- When the liquid level is just below the calibration line indicating the target volume, stop and wait for a few minutes so that the liquid can drain from the cylinder wall

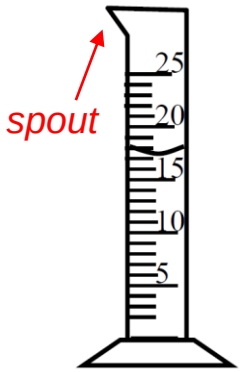


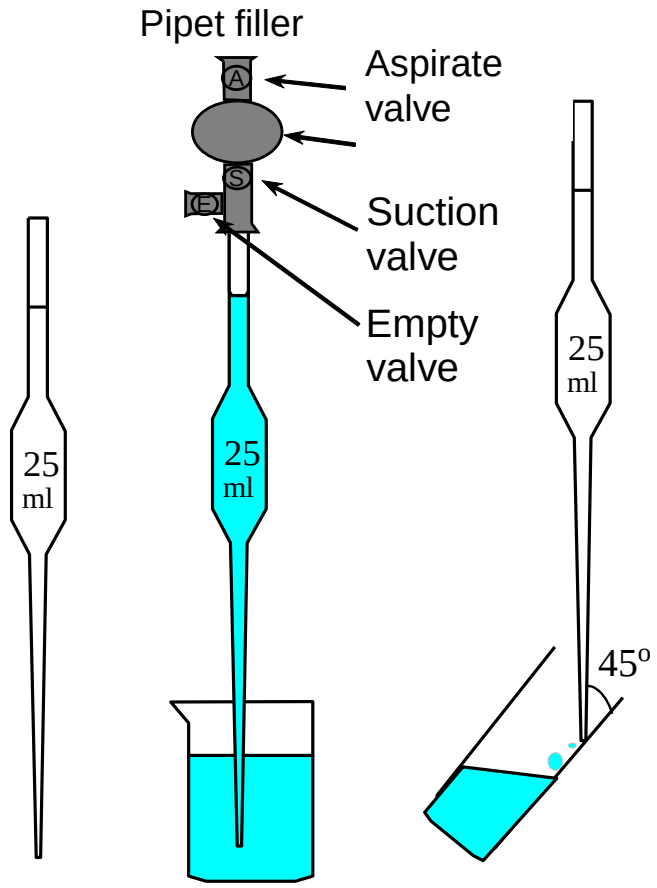
Figure T11-1 Graduated cylinder

- Use a dropper pipet to add liquid to the target volume, or to remove the excess fluid
- Transfer liquid: Slowly tilt the cylinder to pour a steady stream of liquid from the spout (do not splash). Continue until the cylinder is vertically inversed, hold for a few seconds
- Touch the tip of spout against the inner wall of the receiving container in order to transfer the last drop
- Brush-clean the cylinder after use

T11 Video (YouTube link)

T12.1 – Transfer (Volumetric) Pipet

- Clean the pipet and rinse it twice with small amount of the liquid to be transferred
- Press valve **A** of the pipet filler and simultaneously squeeze the bulb to expel air from it, then insert the top of pipet gently into the pipet filler
- Bring the pipet tip below the liquid surface, press valve **S** to draw liquid until it rises above the inscribed line
- Remove the pipet filler and quicky use an index finger to close the top of pipet
- Use finger to adjust the liquid level to the inscribed line. Wipe off any excess liquid near the pipet tip
- Use the other hand to hold the new container. Maintain the pipet in a vertical position and let its tip touch the inner wall of the container. Release the index finger so that liquid is transferred
- Do not force out any liquid remaining at the tip
- Wash the pipet thoroughly after use

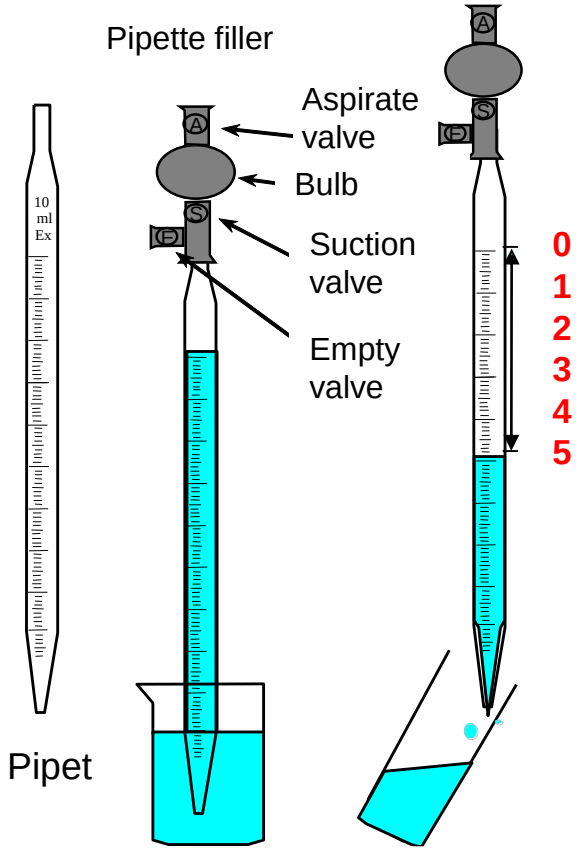


T12 Video (YouTube link)

T12.2 – Measuring (Graduated) Pipet

Deliver 5.00 mL solution – Method 1

- Clean a 10 mL pipet and rinse it twice with small amount of the liquid to be transferred
- Press valve **A** of the pipet filler and simultaneously squeeze the bulb to expel air from it, then insert the top of pipet gently into the pipet filler
- Bring the pipet tip below the liquid surface, press valve **S** to draw liquid to the 0.00 mL marking
- Wipe off any excess liquid near the pipet tip
- Use the other hand to hold the new container. Maintain the pipet in a vertical position and let its tip touch the inner wall of the container. Press valve **E** to drain the liquid to the 5.00 mL marking
- Do not force out any liquid remaining at the tip
- Wash the pipet thoroughly after use

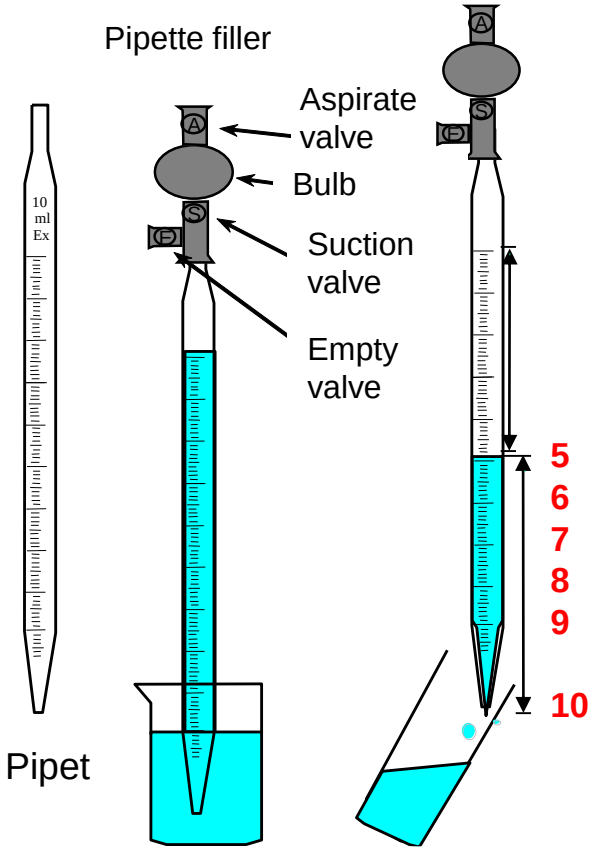


T12 Video (YouTube link)

T12.3 – Measuring (Graduated) Pipet

Deliver 5.00 mL solution – Method 2

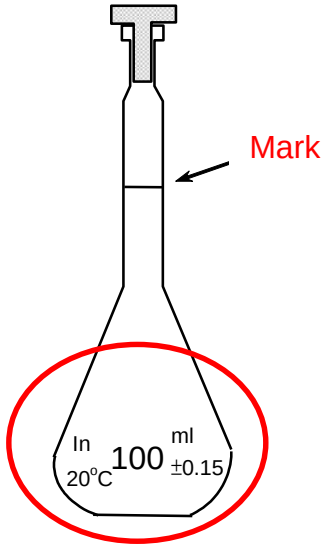
- Clean a 10 mL pipet and rinse it twice with small amount of the liquid to be transferred
- Press valve **A** of the pipet filler and simultaneously squeeze the bulb to expel air from it, then insert the top of pipet gently into the pipet filler
- Bring the pipet tip below the liquid surface, press valve **S** to draw liquid until it rises above the 5.00 mL marking
- Remove the pipet filler and quicky use an index finger to close the top of pipet. Use the finger to adjust the liquid level to the 5.00 mL marking
- Wipe off any excess liquid near the pipet tip
- Use the other hand to hold the new container. Maintain the pipet in a vertical position and let its tip touch the inner wall of the container. Release the index finger so that liquid is transferred
- Do not force out any liquid remaining at the tip
- Wash the pipet thoroughly after use



T12 Video (YouTube link)

T13 – Volumetric Flask

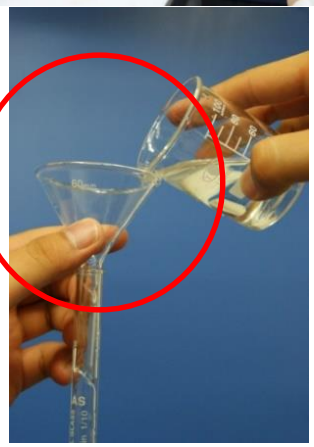
- Clean the volumetric flask thoroughly, then rinse it with a small amount of solvent
- Using a funnel, transfer the solution to be diluted into the volumetric flask
- Fill solvent into the flask until about half full, swirl the flask to let the solution mix
- Add more solvent so that the liquid level approaches (but does not exceed) the inscribed mark
- Use a dropper pipet to add solvent slowly, so that the liquid level matches the inscribed mark
- Install the stopper cap (hold with a finger), invert the flask several times to ensure thorough mixing
- Pour the solution into a beaker for later use (do not store solution in the flask)
- Wash the volumetric flask immediately after use and let it air dry (do not put flask on a hot plate or in an oven)

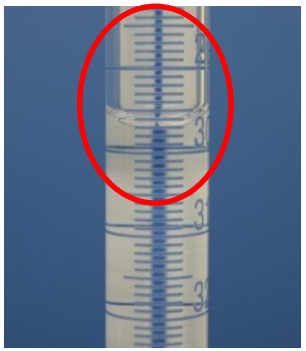


T13 Video (YouTube link)

T14 – Titration

- Clean the buret with DI water, then rinse twice with ~5 mL of titrant (use a funnel to add titrant)
- Open the stopcock to repel the air at the buret tip
- Adjust the height of buret so that its tip is lower than the lid of receiving flask
- Read and record the initial volume (V_i) on the buret to 0.01 mL
- With the stopcock on the right side, use your left hand to control the stopcock while the right hand swirls the receiving flask in a circular motion
- At the titration end point, read and record the final volume (V_f) on the buret to 0.01 mL
- After the experiment, wash the buret and let it dry upside-down on the buret clamp





T14 Video (YouTube link)

T15 – Litmus Paper

Blue → **Red** under acidic conditions

Red → **Blue** under basic conditions

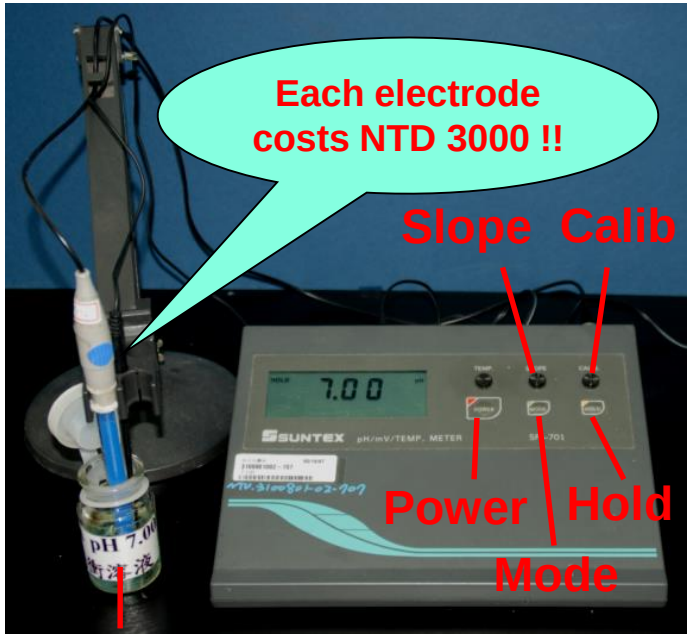
Figure T15-1 Using litmus paper to test acid base property

- Color changes on litmus paper can only determine whether a solution is acidic or alkaline, but not the exact pH of the solution
- In addition to litmus paper, the *universal indicator paper* contains a variety of acid-base indicators and thus can exhibit more colors depending on the pH environment. Therefore the universal indicator paper can inform about the pH value better than the litmus paper
- Dip a clean glass rod into the solution to be tested, then use the same glass rod to touch the litmus paper or universal indicator paper (do not throw test papers directly into the solution). Observe any color change
- When testing gaseous species, wet a litmus paper then place it on the opening of the vessel containing the gas to be tested

T15 Video (YouTube link)

T16.1 – pH Meter

Preparation and calibraion:



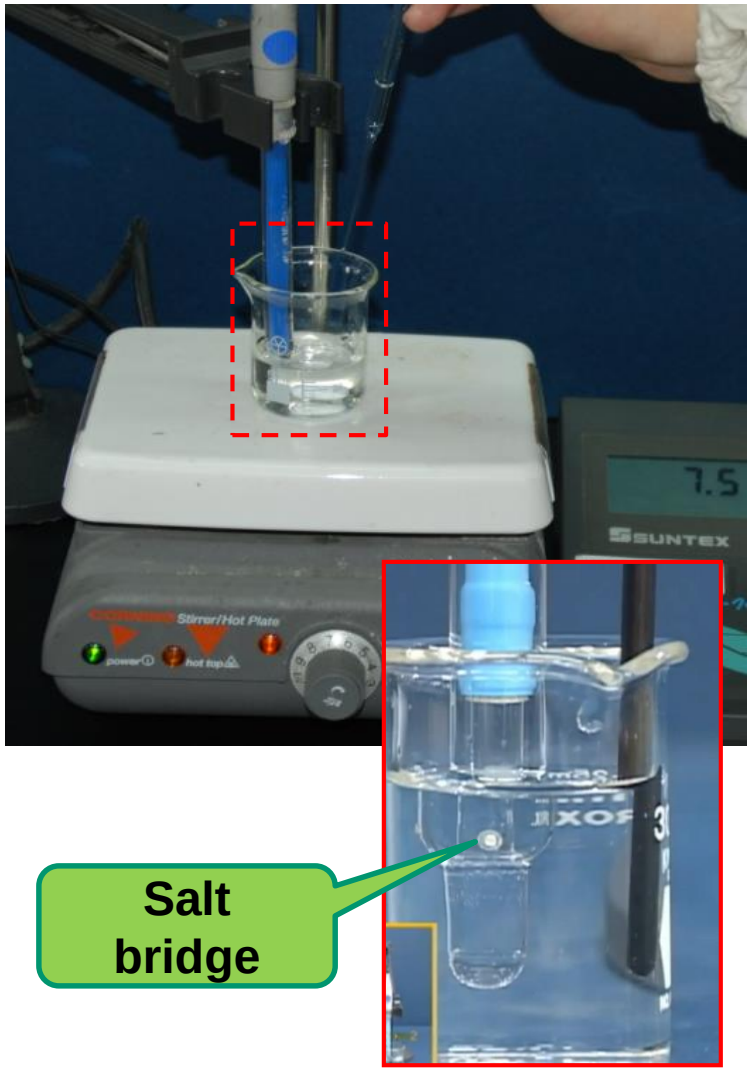
- Press the “POWER” button to turn on the pH meter. Let it warm up for at least 10 min
- Press the “MODE” button several times until “Temp” appears on the screen. Check whether the temperature reading is close to RT
- Press the “MODE” button again to switch to “pH” function
- Press the “HOLD” button to suspend pH reading
- Rotate the electorde cap (3 M KCl) to remove it
- Use a wash bottle with DI water to rinse the electrode, then gently dry it with a tissue paper
- Immerse both the electrode and the thermoprobe into the pH 7.00 buffer solution
- Press “HOLD” again to unfreeze the reading. Adjust the “Calib” knob until 7.00 is shown
- Press “HOLD” to suspend pH reading. Remove the electrode and the thermoprobe, rinse them with DI water then immerse them into the pH 4.00 buffer solution
- Press “HOLD” again to unfreeze the reading. Adjust the “Slope” knob until 4.00 is shown

T16 Video (YouTube link)

T16.2 – pH Meter

Measuring pH:

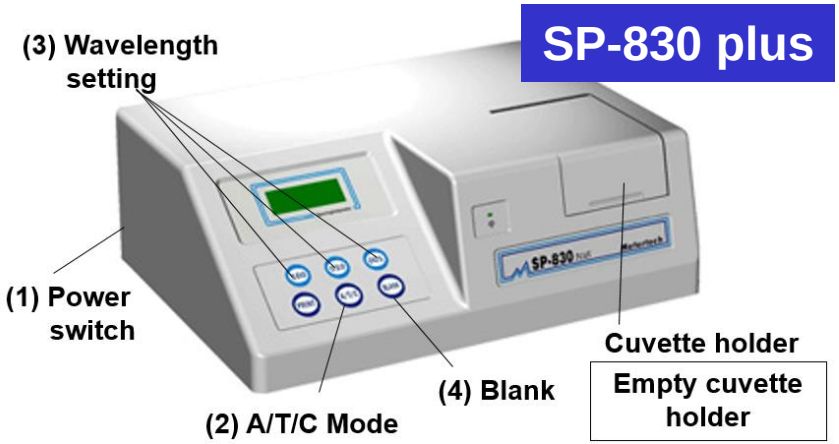
- Use a beaker to hold the solution to be tested. Add a magnetic stir bar and place the beaker atop a stirrer
- When changing between solutions: press the “HOLD” botton on the pH meter, rinse both the electrode and the thermoprobe with DI water, then wipe dry with a tissue paper
- The *salt bridge* at the bottom of electrode should stay below the liquid level, however avoid hitting the electrode with stir bar
- Immerse the electrode in clean DI water when not in use
- For long-term storage, put the electrode back into the 3 M KCl solution in the electrode cap



T16 Video (YouTube link)

T17 – Spectrophotometer

- Turn on the power switch and let the instrument warm up for at least 20 minutes
- Ensure the *cuvette holder* is empty
- Press the "Mode" button several times until "A" (absorbance) appears on the screen
- Set the wavelength to the desired value (e.g. 620 nm)
- Press the "Blank" button to zero the reading
- Place a *cuvette* with blank solution into the cuvette holder. Align the white line on the cuvette toward you (do NOT use regular test tubes in the spectrophotometer)
- Press the "Blank" button to calibrate
- Place a sample solution into cuvette holder
- Close the lid of the sampel compartment, record the absorbance reading

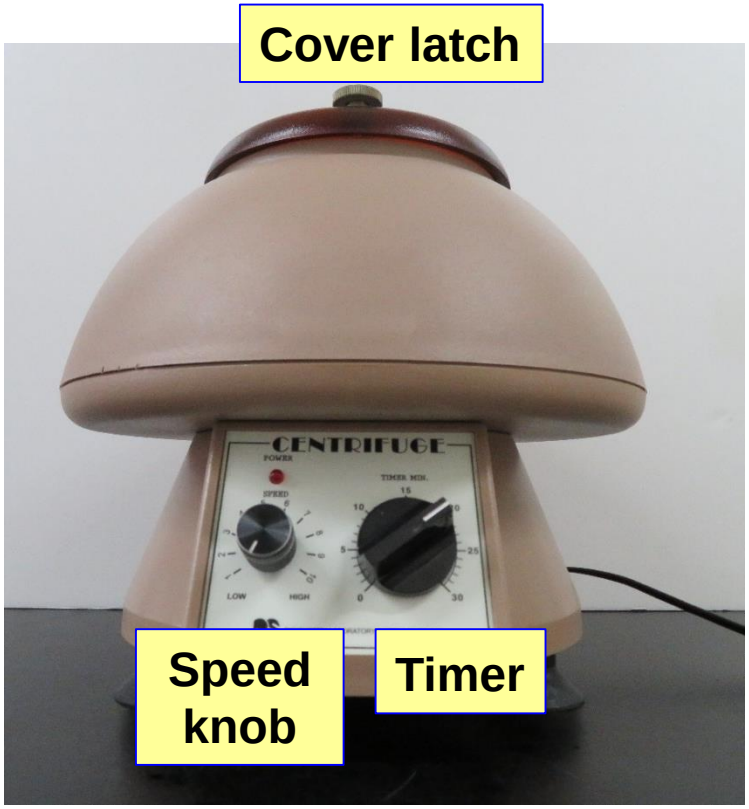


Note – the T17 video shows the older Spectronic 20 model instead of the currently used SP-830

T17 Video (YouTube link)

Table-Top Centrifuge

- Before centrifugation: Arrange centrifuge tubes in a balance configuration. Close the cover latch, and set the speed to 1-2
- Start centrifugation: Set the timer to 1-2 min to start the motor. In cases of unusual sounds or vibrations occuring, stop the centrifuge immediately
- Speeding up: Turn the speed knob up to 5
- Stop centrifugation: Wait until the timer returns to zero, or unplug the power cord. (Do not rotate the timer knob counterclockwise -- this will cause malfunction!)



ARON DSC 200A-1

Lab Dispenser

1) Check the pre-set volume on the dispenser. Do not change the setting unless instructed to do so
2) Place the receiving flask under the tip of dispenser
3) To remove the air bubbles in the dispenser, lightly pull the piston pump up and down for several times
4) Gently pull the piston pump up until it reaches the end of travel range, then slowly push the piston down to obtain the solution