1. Charles Law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ or P/T (vol inc as temp inc, constant pressure)

- Use syringe
- buret as monometer → get approximate pressure
- directly from graduated cylinder
- Water will be driven off when the test tube's heated
- this volume of air is saturated with water vapor that contributes to the total pressure in the flask
- y = 0 (volume)

2. Freezing point Depression (add solute)

- freezing point directly proportional to conc. of particles dissolved in it
  - solute reduces mole fraction, decrease tendency of molecules to escape from solvent phase
- solute added→ lowers temp, lowers tendency of molecules to escape

-solidify = reached freezing point

-freezing point → where lines intersect

- get molecular weight. $\Delta T = K_f m$ ($K_f = (4.6^{\circ}C\text{-kg/mol})$ (ΔT=diff of Freezing pts.)

$\Delta T = 54.5749 - 53.7889 = 0.786$

$0.786 = (4.6)m \quad m = 0.1709$

= molality = $\frac{\text{moles of solute}}{\text{kg of solvent}} = \frac{(0.4998g/MM)}{0.0045\ kg} = 0.1709$ → MM= 650.0195 g/mole

3.Potentiometric Acid-Base Titrations

-inflection points give pKa value

- for characterizing acid; measured across analyte (not use indicator)

-identify unknown where pH changes are great

-convert vol of NaOH to moles acid (divide weight of unknown acid)

-pH from graph (x=vol NaOH)

- vol of NaOH → from graph using $[(-b+\sqrt{b^2-4ac})\div 2a]$, ave of 2 points

-theoretical curve by getting ¼, ½, ¾, 5/4, 3/2 of the volume at equivalence point and equi pt.

- multiplied by molarity of NaOH to get moles → values used to get pH or pKa

$pKa = pH - \log \frac{[A^-]}{[HA]}$

4. Rate of Reactions

- how rate is affected by conc and temp (make Arrhenius plot)
- oxidation of sodium thiosulfate into sulfur, react with HCl (time it takes to become S)

-positive slope (conc and temp inc; rate inc; time dec)

- first order = rate proportional to conc

-cloudiness = start of reaction

- method of initial rates = measuring rates at short times before changes in conc occur
  - under this cuz initial conc are known
  - initial rate and subsequent rates obtained as conc decreased
- more conc, quicker reaction (more collisions)

$K = A(Ea \div RT)$ (Ea = activation energy (J/mol) A = pre-exponential constant)

$m = Ea \div R$ (to get Ea) (m from graph (x))

- Activation energy = minimum energy to start reaction
  - lowering it accelerates the rate by inc conc
- Ln k uses energy/mole while ln 1/t uses energy directly
  - 1/t equals rate of reaction as temp inc.
- conc is directly proportional to 1/t

6. Ksp, G, H of $Ca(OH)_2$ for the dissolution of $Ca(OH)_2$ in Water

- to get apparent equilibrium constant of $Ca(OH)_2$
- solubility of hydroxides is determined by titration

$M_{HCl}V_{HCl} = M_{OH}V_{OH}$ $Ksp = [Ca][OH]$ $\Delta G = -RT\ln K$ (R=8.314) $\Delta G = \Delta H - T\Delta S$

- molar solubility of [Ca] is ½ of the molarity of $[OH^-]$ → 2moles OH for every mole $Ca(OH)_2$ dissociated
- if actual > theoretical → still excess $Ca(OH)_2$ in sol after titration
  → increase HCl, thus increase H ions
- solubility of $Ca(OH)_2$ varies with temp
- CO_2 can increase its solubility
- Adding acid to the solution with a solid base will inc the solubility of the base
- no solid base should be present when titrating
- remaining solids won't affect Ksp → acidity of solution affects Ksp