

- Balance a chemical redox reaction in acid with excess  $H^+$ , and then in base with excess  $OH^-$ .
- Draw a redox reaction using line notation, and identify the reducing agent and the oxidizing agent.
- Determine  $E$  vs SHE, and also vs SCE and vs the vacuum, given a half-reaction with a specified concentration of each species in the reaction, and explain why  $E$  is the same for oxidation and reduction.
- Calculate the cell potential for a reaction measured using a voltmeter, and identify whether the reaction is spontaneous as written.
- For a two-electrode electrochemical cell that is shorted via an ammeter, identify the types of reactions that occur at each electrode and the name of the cell.
- Draw a Latimer diagram for an element, given a series of redox reactions from the CRC Handbook.
- Determine a value for  $E^0$  that is not shown on a Latimer diagram by combining two other half-reactions.
- Determine whether a species disproportionates.
- Draw a Pourbaix diagram including potentials for the HER and the OER, and explain what vertical lines, horizontal lines, and diagonal lines mean.
- When would a Pt wire make a good quasi-reference electrode (QRE)?
- When one sweeps the potential of a polarizable working electrode (WE), what dictates the redox reaction that occurs first and the redox reaction that dominates at a given applied potential bias?
- What is the name of the maximum instrument-limited current and the maximum instrument-limited potential that is possible between the WE and the counter electrode (CE) when using a potentiostat.
- What are the units of " $R \times C$ " and what circuit diagram is used to describe such a charging process?
- What formula is used to calculate the capacitance of the double layer during a CV sweep?
- What is a reasonably accurate method to calculate the ECSA of an electrode?
- How does the  $RC$  time constant change when the WE is placed closer to the reference electrode (RE)?
- How does the  $RC$  time constant change when more inert salt is added as supporting electrolyte?
- How does the  $RC$  time constant change when the sweep rate increases?
- If  $iR$  drop is not limiting the current of your cell, will adding more salt alter the observed current much?
- What is the continuity of mass equation and the master equation that describes the flux of each species?
- What are the three main contributors to mass transfer in electrochemistry?
- Calculate the transport number for each species in an electrochemical cell, given the mobilities and concentrations of each species.
- Interpret a simple balance sheet and accurately label the electrodes as (+) or (-).
- If you increase the concentration of redox-active species and the magnitude of a limiting current plateau increases, what does this tell you about the cause of the limiting current for the condition when the species is charged and for the condition when the species is neutral?
- How does one obtain the diffusion coefficient of a redox-active molecule by Cottrell analysis and/or an Anson plot?
- Over what time range does the Cottrell equation fit chronoamperometry data well, and why?
- What are two ways to design an experiment such that a constant-thickness diffusion layer results after short times, therefore resulting in non-hysteric CVs at moderately slow scan rates and disregarding non-Faradaic currents?
- What is the general trend in activity of a redox-active species as the concentration of electrolyte increases and/or as the magnitude of the charge of the redox-active species increases and/or as the surface coverage of a solid redox-active species decreases? (*The answer is the same for each effect.*)
- *All problems from the laboratory activities and the subsequent assignments.*