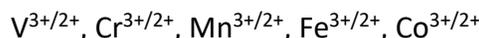


Problem Set 7

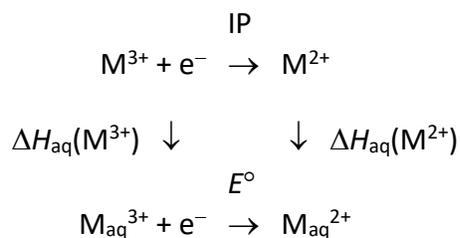
Ch153a – Winter 2026

Due: 27 February 2026

1. (10 points) Consider the following series of redox couples in aqueous solution:



The reduction potentials for these couples (E°) can be defined in terms of the ionization potentials for the gaseous ions (IP) and the heats of hydration for the ions (ΔH_{aq}), as suggested by the following Born-Haber cycle:



- Find the standard reduction potentials (E°) for each pair, citing the reference used.
 - Find the ionization potential for each M^{2+} ion, citing the reference used.
 - Find the enthalpies of hydration for each M^{2+} and M^{3+} ion, citing the reference used.
 - Plot IP, E° , $\Delta H_{\text{aq}}(\text{M}^{3+})$, and $\Delta H_{\text{aq}}(\text{M}^{2+})$ vs. the atomic number of each metal. Explain the trends in terms of the electronic structures of the ions.
2. (10 points) A persistent question in complexes of metals coordinated to Lewis-acidic ligands is the relative π -accepting strength of CO and PF_3 ligands. Explore the literature to find a series of complexes and associated *experimental* data that provide insight(s) into this question (computational studies, as always, will not suffice). On the basis of this literature, explain why you believe CO or PF_3 is the better π -acceptor.