**Unit 12 Test Review Thermodynamics and Electrochemistry**

*Thermo*

Enthalpy vs Entropy (relationship to chemical reactions; meaning of signs; qualitative predictions for processes)

Calculation of standard entropy ΔSo for a reaction from standard molar enthalpies. (Hess)

General understanding (qualitative comparison) of entropy: s vs l vs g ; relationship to size of atom/molecule

Gibbs Free Energy (qualitative meaning)

Calculation of standard ΔGo for a reaction from standard molar free energies. (Hess)

Understanding of ΔGo = ΔHo − TΔSo (spontaneity? Change with temperature?)

Evaluate “thermodynamic favorability” (spontaneity).

Use of ΔGo = −RTlnK

*Electro*

Identification of oxidation states in a reaction (determine species that undergo redox as well as RA/OA)

Writing and using “half-reactions” for redox reactions. LEO GER OIL RIG

Identify anode vs cathode.

Voltaic (galvanic) cells. Identify Red and Ox; use potentials to calculate Eo cell. RED CAT AN OX (volt = j/C)

Spontaneous vs nonspontaneous

Calculate Eo for a reaction given list of reduction potentials. Balance electrons and “Add” HALF reactions to determine Ecell (coefficients do NOT effect potential)

ΔGo = −nFEo and the Nernst Equation (qualitative change Q vs K or quantitative)

Change conditions: Shift?? Effect on voltage? What changes the measured potential?

Relationship of K to cell potential?

Electrolytic cells (electrolysis of molten salts, water, aqueous solutions)

Choosing reactions that will occur based on required voltage.

Electroplating cells

FRQs

1) ΔGo = ΔHo − TΔSo Analyze a reaction. Determine relationships between variables. Stress the system – evaluate shift and changes. ΔGo = −RTlnK

2) Voltaic cell. Determine BEST option for greatest cell potential.

Write half-reactions, overall reaction, calculate Eocell. Label cell diagram. Explain operation. Evaluate change.

3) Electrolytic cell. Identify redox half-reactions. Label diagram. Calculate required voltage. ΔGo = −nFEo

ΔGo = −RTlnK Stoich calculation from current data.

|  |  |
| --- | --- |
| Half reaction | *E*° (V) |
| S4O62−(*aq*) + 2 *e*− → 2 S2O32−(*aq*) | 0.08 |
| I2(*s*) + 2 *e*− → 2 I−(*aq*) | 0.54 |
| O2(*g*) + 2 H+(*aq*) + 2 *e*− → H2O2(*aq*) | 0.68 |

While cleaning up an experiment, a student wishes to dispose of unused solid I2 in a responsible manner. The student decides to convert the solid I2 to I−(*aq*) anion. The student has access to three solutions, H2O2(*aq*),Na2S2O3(*aq*), and Na2S4O6(*aq*), and the standard reduction table shown. 2016 3 e,f

e) Which solution should the student add to I2(*s*) to reduce it to I−(*aq*)? Circle your answer below.

Justify your answer, including a calculation of *E*° for the overall reaction. *(2pts)*

H2O2(*aq*) Na2S2O3(*aq*) Na2S4O6(*aq*)

*Show how half reactions “add”.*

f) Write the balanced net-ionic equation for the reaction between I2 and the solution you selected in part (e). *(1pt)*

The equations below represent reactions associated with the operation of a lead storage battery. The first is the overall reaction that occurs as the battery produces an electrical current, and the second is the half-reaction that occurs at the cathode. 2017 Practice 5

Overall reaction: Pb(*s*) + PbO2(*s*) + 2 H+(*aq*) + 2 HSO4−(*aq*) → 2 PbSO4(*s*) + 2 H2O(*l*) Eo = 2.05V

Cathode half-cell reaction: PbO2(*s*) + 3 H+(*aq*) + HSO4−(*aq*) + 2 *e*− → PbSO4(*s*) + 2 H2O(*l*) Eo = 1.69V

a) Determine the oxidation number of sulfur in the overall reaction. \_\_\_\_\_\_\_ *(1pt)*

b) Write the equation for the half-reaction that occurs at the anode as the battery operates. *(1pt) What is the voltage?*

After the battery has operated for some time, it can be recharged by applying a current to reverse the overall reaction. Calculate the time, in seconds, needed to regenerate 100. g of Pb(*s*) in the battery by applying a current of 5.00 amp.

c) Calculate the time, in seconds, needed to regenerate 100. g of Pb(*s*) in the battery by applying a current of

5.00 amp. *(2pts)*