Electrochemistry

12.

Calculate the standard potential, $E°$, for this reaction from its $\Delta G°$ value.

$$X(s) + Y^{2+}(aq) \longrightarrow X^{2+}(aq) + Y(s) \qquad \Delta G^\circ = 11.0 \text{ kJ}$$

$E^\circ =$ Number [ ] V

17.

A galvanic (voltaic) cell consists of an electrode composed of nickel in a 1.0 M nickel(II) ion solution and another electrode composed of copper in a 1.0 M copper(II) ion solution, connected by a salt bridge. Calculate the standard potential for this cell at 25 °C. Standard reduction potentials can be found here.

$E^\circ_{cell} =$ Number [ ] V

18.

Predict the standard potential for the galvanic cell. Standard reduction potentials can be found here.

$Hg(l)|Hg_2Cl_2(s)|Cl^-(aq)||Hg_2^{2+}(aq)|Hg(l)$

Number [ ] V

19. Rank these species by their ability to act as an oxidizing agent.

Pb^{2+}, Br_2, Na^+, Zn^{2+}

20.

Based on the sign of $E°_{cell}$, classify these reactions as spontaneous or nonspontaneous as written. Assume standard conditions.

$Al^{3+}(aq) + 3Na(s) \rightarrow Al(s) + 3Na^+(aq)$

$Ni^{2+}(aq) + S^{2-}(aq) \rightarrow Ni(s) + S(s)$

$Pb^{2+}(aq) + H_2(g) \rightarrow Pb(s) + 2H^+(aq)$

21.

Calculate the standard free-energy change for the following reaction at 25 °C. Standard reduction potentials can be found here.

$$2Au^{3+}(aq) + 3Ni(s) \rightleftharpoons 2Au(s) + 3Ni^{2+}(aq)$$

$\Delta G^\circ =$ Number [ ] kJ

22.

Using a table of standard reduction potentials, determine the best answer to the following questions.

a) Which of the following reagents would oxidize Fe to Fe^{2+}, but not Pb to Pb^{2+}?

- Co
- Ca^{2+}
- Co^{2+}
- Br^-
- Ca
- Br_2

b) Which of the following reagents would oxidize Ag to Ag^+, but not F^- to F_2?

- Co^{2+}
- Ca^{2+}
- Co
- Ca
- Br^-
- Br_2

23.

Given the following half-reactions and their respective standard reduction potentials

1. $Cu^{3+} + 2e^- \longrightarrow Cu^+ \qquad E_1^\circ = +1.28\ V$
2. $Cu^{2+} + e^- \longrightarrow Cu^+ \qquad E_2^\circ = +0.15\ V$
3. $Cu^{2+} + 2e^- \longrightarrow Cu(s) \qquad E_3^\circ = +0.34\ V$
4. $Cu^+ + e^- \longrightarrow Cu(s) \qquad E_4^\circ = +0.52\ V$

calculate the standard reduction potential for the reduction half-reaction of Cu(III) to Cu(II).

$$Cu^{3+} + e^- \longrightarrow Cu^{2+}$$

$E^\circ =$ Number [ ] V

24.

Complete this table relating the values of E°_{cell} and ΔG° to K.

K	E°_{cell}	ΔG°

> 0 = 0 < 0

26.

Consider a generic redox reaction

$$X(s) + Y^+(aq) \rightleftharpoons X^+(aq) + Y(s)$$

then suppose that the coefficients in the redox reaction are doubled.
How will the following quantities be affected for a voltaic cell under nonstandard conditions?

Doubled	Halved	Squared	No Change

Note that n is written as ν_e or z in some textbooks

N, Q, E, lnQ, E^o

27.

What would the potential of a standard hydrogen electrode (S.H.E.) be if it was under the following conditions?

$[H^+] = 0.57$ M $\quad P_{H_2} = 3.1$ atm $\quad T = 298$ K

Number V

28.

For the following electrochemical cell

$Cu(s)|Cu^{2+}(aq, 0.0155\ M)||Ag^+(aq, 1.50\ M)|Ag(s)$

write the net cell equation. Phases are optional. Do *not* include the concentrations.

Calculate the following values at 25.0 °C using standard potentials as needed.

$E^\circ_{cell} =$ Number V $\quad \Delta G^\circ_{rxn} =$ Number kJ / mol

$E_{cell} =$ Number V $\quad \Delta G_{rxn} =$ Number kJ / mol

29.

The voltage generated by the zinc concentration cell described by,

$Zn(s)|Zn^{2+}(aq, 0.100\ M)||Zn^{2+}(aq, ?\ M)|Zn(s)$

is 25.0 mV at 25 °C. Calculate the concentration of the $Zn^{2+}(aq)$ ion at the cathode.

Number M

30.

When an ion-selective electrode for X^+ was immersed in 0.0510 M XCl, the measured potential was 0.0370 V. What is the concentration of X^+ when the potential is 0.0520 V? Assume that the electrode follows the Nernst equation, the temperature is at 25°C, and that the activity coefficient of X^+ is 1.

$[X^+] =$ Number M

35.

A current of 3.89 A is passed through a $Pb(NO_3)_2$ solution. How long (in hours) would this current have to be applied to plate out 7.60 g of lead?

Number h

36.

Current is applied to a molten mixture of AgF, $ZnCl_2$, and CaS. Standard potentials may be found here.

What is produced at the cathode?

- Ag
- Ca
- F_2
- S
- Zn
- Cl_2

What is produced at the anode?

- Ca
- Zn
- Cl_2
- S
- F_2
- Ag