CHEM-1212
Spring 2016
Third Examination
Form A

Multiple Choice - Choose the BEST Answer

Use the Standard Electrode Potentials at 25°C on the questions below as needed.

Reduction Half-Reaction	***E*° (V)**
$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$	+ 1.50
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 4H_2O(l)$	+ 1.36
$Br_2(l) + 2e^- \rightarrow 2Br^-(aq)$	+ 1.09
$NO_3^-(aq) + 4H^+(aq) + 3e^- \rightarrow NO(g) + 2H_2O(l)$	+ 0.96
$ClO_2(g) + e^- \rightarrow ClO_2^-(aq)$	+ 0.95
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+ 0.80
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+ 0.77
$I_2(s) + 2e^- \rightarrow 2I^-(aq)$	+ 0.54
$Cu^+(aq) + e^- \rightarrow Cu(s)$	+ 0.52
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+ 0.34
$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow H_2SO_3(aq) + H_2O(l)$	+ 0.17
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0 (defined)
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	- 0.13
$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$	- 0.14
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	-0.26
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	- 0.45
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	- 0.76
$Mn^{2+}(aq) + 2e^- \rightarrow Mn(s)$	- 1.18
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	-1.66
$K^+(aq) + e^- \rightarrow K(s)$	- 2.93

Multiple Choice - Choose the BEST Answer

1. What is the change in entropy, ΔS, when the volume 0.0250 mol of $O_2(g)$ increases from 1.5 L to 3.5 L at constant temperature of 298.15 K?

A) -0.0017 J/K
B) 0.0017 J/K
C) -0.18 J/K
D) 0.18 J/K
E) -0.0211 J/K

2. When the temperature of a liquid increases, the entropy of that substance will also increase. Which of the following is a reason that this occurs?

A) The vibrational energy increases.
B) The reaction is spontaneous.
C) The total energy can be distributed among the individual molecules in an increasing number of ways.
D) Only A and C
E) All of the above

3. Which of the following scenarios will cause an increase in entropy of the system?

A) expansion of a gas
B) decrease in volume
C) decrease in temperature
D) B and C only
E) A, B and C

4. Which of the following are true of a chemical reaction at equilibrium?

I. ΔS_{total} equals zero
II. ΔG_{rxn} equals zero.
III. ΔG°_{rxn} equals zero.

A) II only
B) II and III only
C) III only
D) I and II only
E) I, II and III

Multiple Choice - Choose the BEST Answer

5. Which of the following would you expect to have the greatest standard molar entropy?

A) gaseous oxygen
B) solid calcium carbonate
C) liquid acetic acid
D) liquid methanol
E) All of the above substances will have the same standard molar entropy because they are all at standard conditions

6. Considering the following reaction: $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ and the information below. Which of the following statements are true about the reaction at 25°C?

Substance	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)	$S°$ (J/mol.K)
$CaCO_3(s)$	-1207.6	-1129.1	91.7
$CaO(s)$	-634.9	-603.3	38.1
$CO_2(g)$	-393.5	-394.4	213.8

A) $\Delta H°$ is negative, $\Delta S°$ is negative and $\Delta G°$ is positive
B) $\Delta H°$ is positive, $\Delta S°$ is positive and $\Delta G°$ is positive
C) $\Delta H°$ is positive, $\Delta S°$ is positive and $\Delta G°$ is negative
D) $\Delta H°$ is negative, $\Delta S°$ is negative and $\Delta G°$ is negative
E) $\Delta H°$ is positive, $\Delta S°$ is negative and $\Delta G°$ is negative

7. At 25°C, K_w for the dissociation (autoionization) of water is 1.0×10^{-14}. What is the value of $\Delta G°$ for the dissociation (autoionization) of water at 25°C?

A) -1750 kJ
B) -79.9 kJ
C) -34.7 kJ
D) 34.7 kJ
E) 79.9 kJ

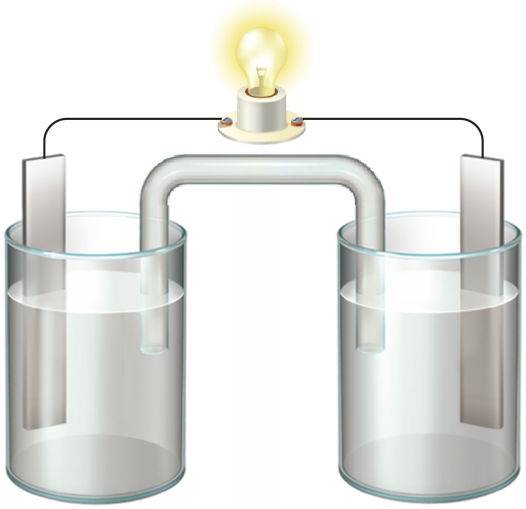
8. When a double helix of DNA forms from two singled strands of DNA, the result is a release of heat, a decrease in entropy of the system and a total entropy increase. Which statement is true regarding the combination of single strands of DNA to form a double stranded DNA helix?

A) $\Delta S_{surroundings} > \Delta S_{system}$
B) $\Delta S_{surroundings} < \Delta S_{system}$
C) $\Delta S_{surroundings} = \Delta S_{system}$
D) $\Delta S_{surroundings} < \Delta S_{total}$
E) There is not enough information to compare $\Delta S_{surroundings}$ to ΔS_{system} to ΔS_{total}

Multiple Choice - Choose the BEST Answer

***** Use the following image and information of the galvanic cell below to answer the next **two** questions. ********

The galvanic cell below contains silver and aluminum electrodes.



9. Which of the following statement(s) is(are) true about the galvanic cell?

A) At the cathode, silver is oxidized from an oxidation state of +1 to 0.
B) At the anode, aluminum is reduced from an oxidation state of 0 to +3.
C) Electrons travel from the aluminum half cell to the silver half cell.
D) One electron is transferred per mole of reaction.
E) At the anode, silver is oxidized from an oxidation state of +1 to 0.

10. Which of the following statement(s) is(are) true concerning a salt bridge in a galvanic cell?

A) Cations from the salt in the salt bridge travel to the cathode to neutralize the Ag^+ ions and keep it electrochemically balanced.
B) Anions from the salt in the salt bridge travel to the anode to neutralize the Ag^+ and keep it electrochemically balanced.
C) Cations from the salt in the salt bridge travel to the cathode to neutralize the Al^{3+} ions and keep it electrochemically balanced.
D) Anions from the salt in the salt bridge travel to the anode to neutralize the Al^{3+} ions and keep it electrochemically balanced.
E) None of the above.

Multiple Choice - Choose the BEST Answer

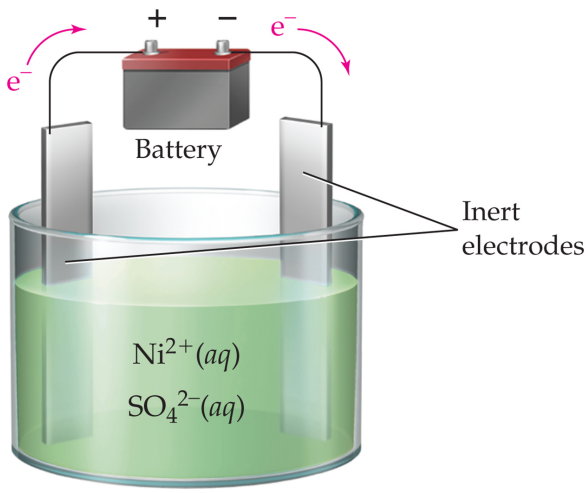
11. Balance the following reaction in basic solution.

$$IO_3^-(aq) + MnO_4^-(aq) \rightarrow MnO_2(s) + IO_4^-(aq)$$

What is the coefficient in front of $H_2O(l)$ and which side of the equation is it on in the overall, balanced reaction?

A) 1, left side of the equation
B) 6, left side of the equation
C) 4, right side of the equation
D) 10, right side of the equation
E) H_2O is not present in the overall, balanced equation.

12. Which of the following is the balanced half reaction at the anode in the cell shown below?



A) $Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$
B) $SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow H_2SO_3(aq) + H_2O(l)$
C) $Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$
D) $H_2SO_3(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 4H^+(aq) + 2e^-$
E) More information is needed to determine the half reaction occurring at the anode.

13. Which molecule or ion contains uranium in the most positive oxidation state?

A) UO_2
B) U_2O_5
C) UO_2SO_4
D) UO_2Cl
E) They all the same oxidation state.

Multiple Choice - Choose the BEST Answer

14. What is the correct cell notion for the redox reaction given below?

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

A) $Pt(s) \mid H_2(g) \mid H^+(aq) \mid Pb(s) \mid Pb^{2+}(aq)$

B) $Pb(s) \mid Pb^{2+}(aq) \parallel 2\ H^+(aq) \mid H_2(g)$

C) $Pb(s) \mid Pb^{2+}(aq) \parallel H^+(aq) \mid H_2(g) \mid Pt(s)$

D) $Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Pb(s) \mid Pb^{2+}(aq)$

E) $H_2(g) \mid H^+(aq) \parallel Pb(s) \mid Pb^{2+}(aq)$

15. A galvanic cell is made using the following reaction:

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

The cell potential is found to be 0.58 V when $[Zn^{2+}] = 0.75\ M$ and $P_{H2} = 0.95$ atm. What is the pH of the cathode solution when the cell is at 298.15 K?

A) pH = 0.83
B) pH = 3.11
C) pH = 3.63
D) pH = 4.06
E) pH = 6.22

16. One method of hydrogen production is the electrolysis of water. How many grams of $H_2(g)$ will be produced if 250. A is applied for 30. minutes? Use the following equations as needed.

Oxidation: $2\ H_2O(l) \rightarrow O_2(g) + 4\ H^+(aq) + 4e^-$
Reduction: $4\ H_2O(l) + 4e^- \rightarrow 2\ H_2(g) + 4\ OH^-(aq)$
Overall Cell Reaction: $6\ H_2O(l) \rightarrow O_2(g) + 2\ H_2(g) + 4\ H^+(aq) + 4\ OH^-(aq)$

A) 0.58 g
B) 3.2 g
C) 4.7 g
D) 2.4×10^4 g
E) 2.7×10^4 g

Multiple Choice - Choose the BEST Answer

17. Which of the following are true statements about Standard Reduction Potentials?

A) The standard hydrogen electrode is used as a reference half-cell.
B) When a standard hydrogen electrode is used, the entire potential of the cell is attributed to the non standard electrode.
C) The standard hydrogen electrode consists of an inert platinum electrode in 1 *M* $H^+(aq)$ with $H_2(g)$ at 1 atm.
D) A and C only
E) A, B and C

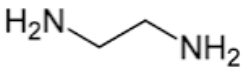
18. You are working with 1 *M* HNO_3 (aq) in lab when your gold necklace breaks and falls into a beaker of the acid. Which of the following situations is most likely to occur? Assume the necklace is pure gold.

A) The solid gold will spontaneously oxidize to form $Au^{3+}(aq)$ in solution.
B) The strong acid cannot oxidize gold under standard conditions; therefore, nothing would happen.
C) The oxidation of $Au^{3+}(aq)$ in solution would have an $E°_{cell} = 0.54V$.
D) Both A and C are correct.
E) There is not enough information to make any of the above predictions.

19. In the formation of a coordination compound, what acts as the Lewis base?

A) ligand
B) metal ion
C) d-electrons
D) exterior ion used to balance charge
E) none of the above

20. What is the coordination number of the Co^{3+} ion in $[Co(en)_2Cl_2]Cl$?

en = 

A) 2
B) 4
C) 5
D) 6
E) 7

21. What is the oxidation number of the iron ion in $[Fe(NH_3)_5Br]SO_4$?

A) +1
B) +2
C) +3
D) +4
E) +5

22. Which form of the exam do you have?
A) A B) B