



KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

CHEMISTRY DEPARTMENT

CHEM-102-132

SECOND MAJOR EXAM

April 21st, 2014

TEST CODE 000

STUDENT NUMBER: _____

NAME : _____

SECTION NUMBER: _____

INSTRUCTIONS

1. Write your student number, name, and section number on the *EXAM COVER* page.
2. Write your student number, section number, and your name on your *EXAM ANSWER FORM*.
3. **Bubble in pencil** your student number and your section number on the *EXAM ANSWER FORM*.
4. **Bubble in pencil** on your *EXAM ANSWER FORM* the correct answer to each of the questions. .
You must not give more than *ONE* answer per question.
5. At the end of the exam return the *EXAM ANSWER FORM* to the proctor.
6. The exam contains **20 multiple choice questions** and the time allowed is **80 min.**

**PLEASE TURN OFF YOUR CELL PHONE AND
PLACE IT UNDER YOUR SEAT**

Important constants

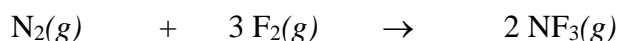
Gas Constant (R)	= 0.08206	L.atm/(mol.K)
	= 8.314	J/(mol.K)
	= 8.31×10^7	$\text{g.cm}^2/(\text{sec}^2.\text{mol.K})$
Planck's Constant (h)	= 6.626×10^{-34}	J.sec/particle
	= 6.626×10^{-34}	$\text{kg.m}^2/(\text{sec.particle})$
Speed of light (c)	= 2.998×10^8	m/sec
Avogadro's number (N)	= 6.022×10^{23}	particles/mole
Bohr's Constant (R _H)	= 2.179×10^{-18}	J/particle
Faraday (F)	= 96485	Coulombs/mol e ⁻
Specific heat of H ₂ O	= 4.18	J/(g.°C)

Name: _____ Date: _____

1. Some substances (such as lanthanide salts) are more soluble at low temperatures than at high temperatures (unlike most salts, for which the opposite is true). What does this say about the thermodynamic parameters of this dissolution process?

- A) ΔS is negative.
- B) ΔS is positive.
- C) ΔS is zero.
- D) ΔG is zero.

2. Consider the following reaction at 527 °C



An equilibrium mixture contains the following partial pressures: $P_{\text{N}_2} = 0.021$ atm; $P_{\text{F}_2} = 0.063$; $P_{\text{NF}_3} = 0.48$ atm. Calculate ΔG° for the reaction at 527 °C.

- A) -71 kJ/mol
- B) -23 kJ/mol
- C) -39 kJ/mol
- D) -47 kJ/mol

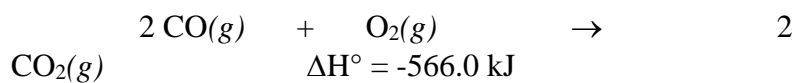
3. For a certain process at 25 °C, $\Delta H = 128.9$ kJ/mol and $\Delta G = 33.5$ kJ/mol. Above what minimum temperature will this process become spontaneous?

- A) 403 K
- B) 502 K
- C) 1150 K
- D) 320. K

4. The solubility product constant (K_{sp}) for the reaction $\text{AgBr}(s) \rightleftharpoons \text{Ag}^+(aq) + \text{Br}^-(aq)$ is 7.7×10^{-13} at 25°C. Calculate ΔG for this reaction when $[\text{Ag}^+] = 1.0 \times 10^{-2} M$ and $[\text{Br}^-] = 1.0 \times 10^{-3} M$.

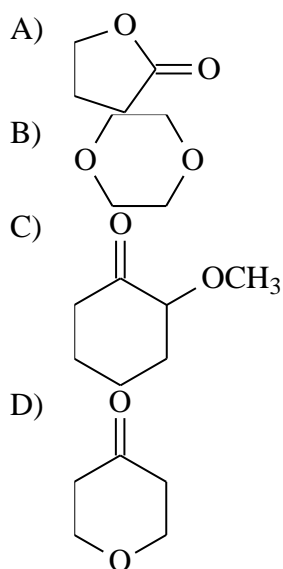
- A) +40.6 kJ/mol
- B) +69.1 kJ/mol
- C) -97.5 kJ/mol
- D) -69.1 kJ/mol

5. Predict which of the following statements is true with regard to the spontaneity of the reaction below:

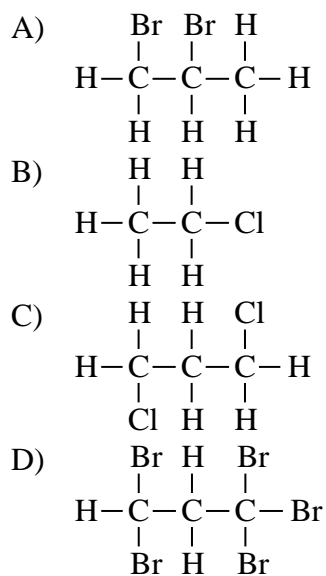


- A) The reaction is spontaneous at low temperatures, but not at high temperatures.
 B) The reaction is not spontaneous at any temperature.
 C) The reaction is spontaneous at all temperatures.
 D) The reaction is spontaneous at high temperatures, but not at low temperatures.

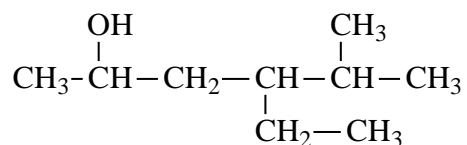
6. Which compound is an ester?



7. Which structure can exhibit optical isomerism?

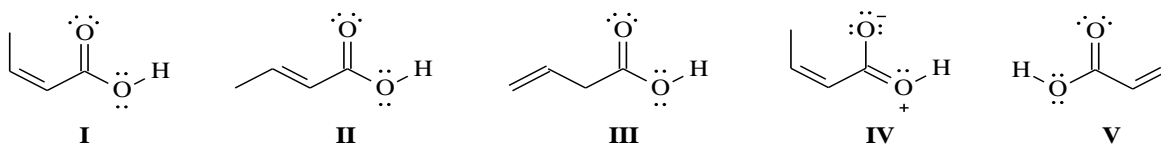


8. Name the compound



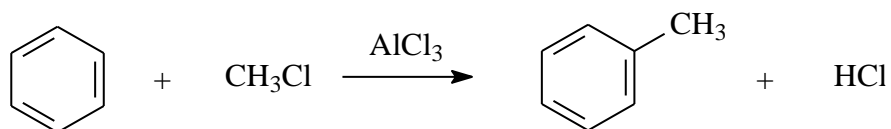
- A) 4-Ethyl-5-methyl-2-hexanol
 B) 4-Ethyl-2-hydroxy-5-methylhexane
 C) 4-Ethyl-4-isopropyl-2-butanol
 D) 3-Ethyl-2-methyl-5-hexanol

9. Which statement is **FALSE** considering the following structures?



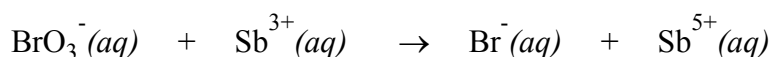
- A) I and V are enantiomers.
 B) I and II are geometric isomers.
 C) I and III are constitutional isomers.
 D) I and IV are resonance structures.

10. Benzene will react with chloromethane in the presence of AlCl_3 as a catalyst to produce toluene and hydrogen chloride. Select the correct reaction type for the process.



- A) substitution
 B) addition
 C) reduction-oxidation (redox)
 D) elimination

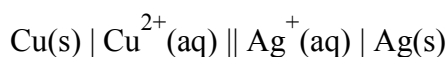
11. Balance the following redox equation



in an acidic medium using the set of smallest whole-number coefficients. The sum of all coefficients in the whole equation is:

- A) 17
- B) 20
- C) 12
- D) 8

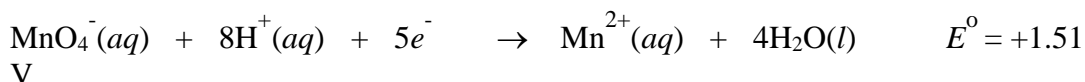
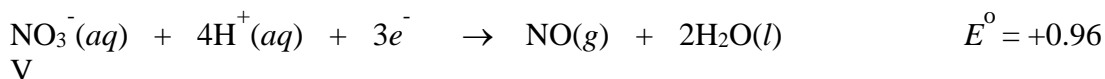
12. A voltaic cell with the following notation



is prepared using copper and silver. Which of the following processes occurs at the cathode?

- A) $\text{Ag}^+(aq) + e^- \rightarrow \text{Ag}(s)$
- B) $\text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s)$
- C) $\text{Ag}(s) \rightarrow \text{Ag}^+(aq) + e^-$
- D) $\text{Cu}(s) \rightarrow \text{Cu}^{2+}(aq) + 2e^-$

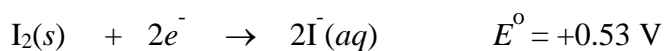
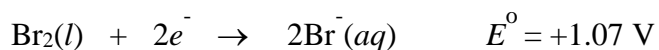
13. Given the following two half reactions:



Which of the following statement is **CORRECT** under standard-state conditions?

- A) $\text{MnO}_4^-(aq)$ will oxidize $\text{NO}(g)$ to produce $\text{NO}_3^-(aq)$.
- B) $\text{MnO}_4^-(aq)$ and $\text{NO}_3^-(aq)$ can not undergo a redox reaction because the numbers of electrons in the two half reactions are different.
- C) $\text{NO}_3^-(aq)$ will be reduced by $\text{Mn}^{2+}(aq)$ to produce $\text{MnO}_4^-(aq)$.
- D) $\text{NO}(g)$ and Mn^{2+} will react to produce $\text{MnO}_4^-(aq)$ and $\text{NO}_3^-(aq)$.

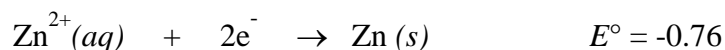
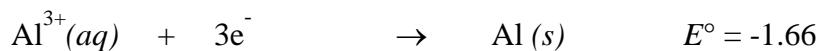
14. Given the standard reduction potentials below



For the reaction $\text{Br}_2(l) + 2\text{I}^-(aq) \rightleftharpoons 2\text{Br}^-(aq) + \text{I}_2(s)$ at 25°C, the equilibrium constant is:

- A) 2.0×10^{18}
- B) 7.4×10^{34}
- C) 5.1×10^{-7}
- D) 33

15. Given the following reduction potentials:



You make a cell with an aluminum electrode in a solution of aluminum nitrate, and a zinc electrode in a solution of zinc nitrate. If you could increase the concentration of Zn^{2+} , which of the following is true about the cell potential, E_{cell} ?

- A) It would increase.
- B) It would decrease.
- C) It would remain constant.
- D) Cannot be determined.

16. If 12% of a certain radioisotope decays in 5.2 years, what is the half-life of this isotope?

- A) 28 yr
- B) 22 yr
- C) 1.7 yr
- D) 0.59 yr

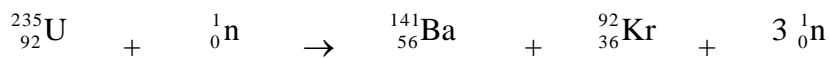
17. The mass of one ${}_{27}^{59}\text{Co}$ nucleus is 58.918386 amu. Calculate the binding energy for ${}_{27}^{59}\text{Co}$ in units of MeV per nucleon.

Proton (${}^1_1\text{H}$) mass = 1.00728 amu; Neutron (${}^1_0\text{n}$) mass = 1.00866 amu;

1 amu = 1.66056×10^{-27} kg; 1 MeV = 1.60×10^{-13} J.

- A) 8.78
- B) 514
- C) 19.0
- D) 16.1

18. Which process does the following reaction represent?



- A) nuclear fission.
- B) alpha decay.
- C) beta emission.
- D) nuclear fusion.

19. An isotope that is unstable because of having too many neutrons is most likely to decay by a/an _____ process.

- A) β^- emission
- B) electron capture
- C) β^+ emission
- D) α emission

20. Which of the following statements is **WRONG**?

- A) The mass defect arises because the sum of masses of the component nucleons is less than that of the nucleus.
- B) Fusion requires a very high temperature in order to begin, which is a problem for scientists.
- C) The smallest amount of a radioactive material that will support a self-sustained reaction is called the critical mass.
- D) As atomic mass increases, the proton/neutron ratio of stable nucleus decreases.

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10								
IA	IIA							IIIA	IVA	VA	VIA	VIIA	VIIIA				
1 H 1.0079	2 He 4.0026	3 Li 6.941	4 Be 9.0122	5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180	11 Na 22.990	12 Mg 24.305	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La* 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac** (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs 265	109 Mt (268)	110 Uun (269)	111 Uuu (272)	112 Uub (277)	113	114	115	116	117	118

58	59	60	61	62	63	64	65	66	67	68	69	70	71
* Ce 140.12	Pr 140.91	Nd 144.24	Pm (145)	Sm 150.36	Eu 151.96	Gd 157.25	Tb 158.93	Dy 162.50	Ho 165.93	Er 167.26	Tm 168.93	Yb 173.04	Lu 174.97
** Th 232.04	Pa 231.04	U 238.03	Np (237)	Pu (244)	Am (243)	Cm (247)	Bk (247)	Cf (251)	Es (252)	Fm (257)	Md (258)	No (259)	Lr (262)

Answer Key

1. A
2. A
3. A
4. A
5. A
6. A
7. A
8. A
9. A
10. A
11. A
12. A
13. A
14. A
15. A
16. A
17. A
18. A
19. A
20. A