Chemistry 1220, Section 1
Second Hour Exam – 2nd Version
Oct. 25, 2001
Dr. Lisa M. Berreau

Instructions:

Do not begin until 1:30 PM. The exam must be turned in by 2:20 PM.

⇒ The exam has 25 questions. Each question is worth 4 points for a total of 100 points. A periodic table is located on the last page.

⇒ Use only a #2 pencil to mark the answer on the ScanTron sheet. Yow will turn in only the ScanTron sheet and you can keep the rest of the exam. Your exam results will be emailed to you. You can check your answers with the answer key that will be posted on-line immediately after the exam on my website under Exam Scores and Statistics.

⇒ On the ScanTron sheet print your name and identification number in the areas indicated. Indicate a four character code (any combination of letters and numbers - the same code that you used for the first exam) under "version#" for the purpose of reporting final grades.

$pH = pKa + \log([base]/[acid])$

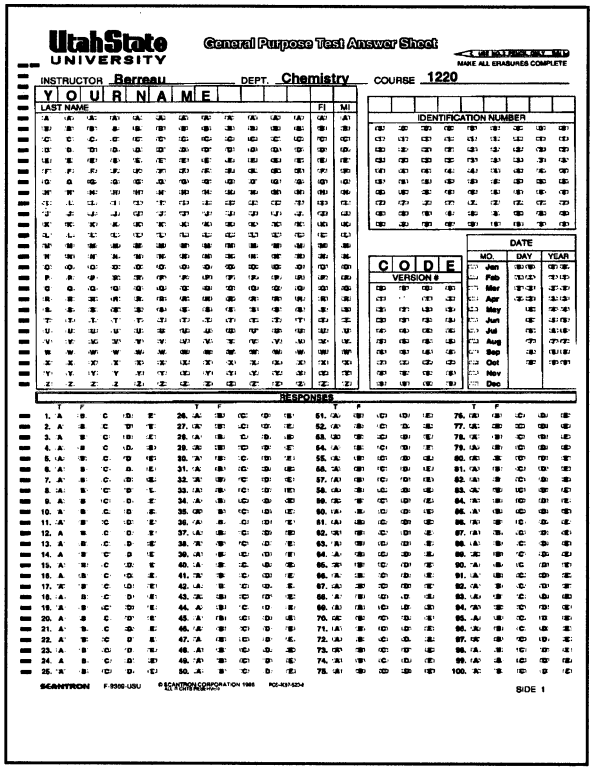
$\Delta S° = \Sigma\, nS°(products) - \Sigma\, mS°(reactants)$

$\Delta G = \Delta H - T\Delta S$

$\Delta G° = \Sigma\, nG_f°(products) - \Sigma\, mG_f°(reactants)$

$\Delta G = \Delta G° + RT\ln Q$ ($R = 8.314$ J/mol·K)

$\Delta G° = -RT\ln K$ ($R = 8.314$ J/mol·K)



1. Compounds found in fossil fuels that contain _____ are primarily responsible for acid rain.

   (a) carbon
   (b) hydrogen
   (c) sulfur
   (d) phosphorus

2. If $\Delta G°$ for a reaction is greater than zero, then _____.

   (a) $K = 0$
   (b) $K = 1$
   (c) $K > 1$
   (d) $K < 1$

3. Of the following, _____ is the strongest acid.

   (a) Cl_3C-COOH
   (b) Cl_2CH-COOH
   (c) $ClCH_2$-COOH
   (d) CH_3-COOH

4. 50.50 mL of 0.115 M HF is titrated with 0.1200 M NaOH. What is the pH when 25.00 mL of NaOH have been added? (K_a for HF is 6.8×10^{-4}).

   (a) 5.118
   (b) 3.189
   (c) 6.168
   (d) 3.547

5. The entropy of the universe is _____.

   (a) constant
   (b) continually decreasing
   (c) continually increasing
   (d) zero

6. Calculate the pH of a 1.0 L aqueous solution containing 0.40 mol of HF and 0.10 mol of HCl (K_a for HF = 6.8×10^{-4})

   (a) 0.40
   (b) 1.0
   (c) 0.016
   (d) 2.6

7. Of the following, the entropy of _____ is very large relative to the others.

(a) HCl(l)
(b) HCl(g)
(c) HCl(s)
(d) HBr(s)

8. The region of the atmosphere closest to the surface of the earth is called the _____.

(a) mesosphere
(b) stratosphere
(c) thermosphere
(d) troposphere

9. In which aqueous system is PbI_2 least soluble?

(a) H_2O
(b) 1.0 M HNO_3
(c) 0.8 M KI
(d) 0.2 M HI

10. The equilibrium constant for a reaction is 0.48 at 25 °C. What is the value of $\Delta G°$ (in kJ) at this temperature?

(a) 1.8
(b) –4.2
(c) 4.2
(d) 1.5×10^2

11. Determine the pH of a solution prepared by dissolving 0.75 mol of NH_3 and 0.25 mol of NH_4Cl in a liter of solution (K_b for NH_3 is 1.8×10^{-4}).

(a) 4.27
(b) 8.78
(c) 10.73
(d) 5.22

12. Which one of the following reactions would have a positive value for $\Delta S°$?

(a) $Ba(OH)_2(s) + CO_2(g) \rightarrow BaCO_3(s) + H_2O(l)$
(b) $N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$
(c) $2\,SO_3(g) \rightarrow 2\,SO_2(g) + O_2(g)$
(d) $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

13. CFC stands for _____.

(a) chlorinated freon compound
(b) caustic fluorine carbohydrate
(c) chlorofluorocarbon
(d) carbonated fluorine compound

14. Consider the titration of 25.0 mL of 0.723 M $HClO_4$ with 0.273 M KOH. The H^+ concentration before any KOH is added is _____ M.

(a) 0.439
(b) 1.00×10^{-7}
(c) 2.81×10^{-13}
(d) 0.723

15. Consider the reaction:

$$FeO(s) + Fe(s) + O_2(g) \rightarrow Fe_2O_3(s)$$

Given the following table of thermodynamic data, determine the temperature (in °C) above which the reaction is nonspontaneous.

Substance	$\Delta H°_f$ (kJ/mol)	S° (J/mol-K)
FeO(s)	-271.9	60.75
Fe(s)	0	27.15
$O_2(g)$	0	205.0
$Fe_2O_3(s)$	-822.16	89.96

(a) 618.1
(b) 756.3
(c) 2439
(d) 1235

16. Which of the following could be added to a solution of KF to prepare a buffer?

(a) NaOH
(b) $KC_2H_3O_2$
(c) HF
(d) NaF

17. What is the molar solubility of PbS ($K_{sp} = 8.0 \times 10^{-28}$)?

(a) 4.0×10^{-28}
(b) 2.8×10^{-14}
(c) 6.4×10^{-55}
(d) 8.0×10^{-19}

18. Given the following table of thermodynamic data, calculate $\Delta S°$ (in J/K) for the reaction:

$$C_2H_2(g) + 2\,H_2(g) \rightarrow C_2H_6(g)$$

Substance	S° (J/mol-K)
$C_2H_2(g)$	200.8
$H_2(g)$	130.58
$C_2H_6(g)$	229.5

(a) –101.88
(b) –111.98
(c) –232.46
(d) +111.98

19. A _____ yields a titration curve with an initial pH of 13.00, an equivalence point at pH = 7.0, and a relatively long, narrow vertical middle section.

(a) Strong base titrated by a strong acid
(b) Weak acid titrated by a strong base
(c) Weak base titrated by a strong acid
(d) Strong acid titrated by a strong base

20. Which one of the following CAN act as a Lewis acid?

(a) Cl^-
(b) BF_3
(c) CN^-
(d) NH_3

21. What is the typical pH of natural, unpolluted rainwater?

(a) 7
(b) 9
(c) 12
(d) 5

22. Which molecule below should have the highest gas-phase absolute entropy?

(a) H_2
(b) C_2H_2
(c) CH_4
(d) C_2H_6

23. Consider the titration of 50.0 mL of 0.217 M HN_3 (K_a = 2.6 x 10^{-5}) with 0.183 M NaOH. Caculate the pH of the solution after addition of 59.3 mL of NaOH solution.

(a) 2.61
(b) 8.79
(c) 12.21
(d) 4.59

24. What change will be caused by addition of a small amount of HCl to a solution containing the following equilibrium:

$$HF(aq) = H^+(aq) + F^-(aq)$$

(a) The concentration of H^+ will increase significantly.
(b) The concentration of F^- will increase as will the concentration of H^+.
(c) The concentration of HF will decrease and the concentration of F^- will increase.
(d) The concentration of F^- will decrease and the concentration of HF will increase.

25. Which of the following is the <u>STRONGEST</u> acid?

(a) CH_4
(b) NH_3
(c) H_2O
(d) HF