

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. You 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.

$$pH = pK_a + \log \left(\frac{[base]}{[acid]} \right)$$

$$\Delta S^\circ = \sum nS^\circ(\text{products}) - \sum mS^\circ(\text{reactants})$$

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

$$\Delta G^\circ = \sum nG_f^\circ(\text{products}) - \sum mG_f^\circ(\text{reactants})$$

$$\Delta G = \Delta G^\circ + RT \ln Q \quad (R = 8.314 \text{ J/mol}\cdot\text{K})$$

$$\Delta G^\circ = -RT \ln K \quad (R = 8.314 \text{ J/mol}\cdot\text{K})$$

Utah State UNIVERSITY General Purpose Test Answer Sheet HAVE ALL GRADINGS COMPLETE

INSTRUCTOR: Berreau DEPT: Chemistry COURSE: 1220

YOUR NAME: LAST NAME: _____ FI MI _____

IDENTIFICATION NUMBER: _____

C O D E				DATE	
VERSION #	MO	DAY	YEAR		
	Jan	01-01	02-01		
	Feb	02-01	03-01		
	Mar	03-01	04-01		
	Apr	04-01	05-01		
	May	05-01	06-01		
	Jun	06-01	07-01		
	Jul	07-01	08-01		
	Aug	08-01	09-01		
	Sep	09-01	10-01		
	Oct	10-01	11-01		
	Nov	11-01	12-01		
	Dec	12-01	01-01		

RESPONSES

1. A	2. B	3. C	4. D	5. E	6. F	7. G	8. H	9. I	10. J	11. K	12. L	13. M	14. N	15. O	16. P	17. Q	18. R	19. S	20. T	21. U	22. V	23. W	24. X	25. Y
------	------	------	------	------	------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

SCANTRON F-5000 (REV. 8/97) © 1997 UNIVERSITY MICROFILMS INTERNATIONAL 1000 N ZEEB RD ANN ARBOR MI 48106-1500

SIDE 1

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

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

c

2. If ΔG° for a reaction is greater than zero, then _____.

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

$$\Delta G = -RT \ln K$$

d

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

- (a) $\text{Cl}_3\text{C-COOH}$
 (b) $\text{Cl}_2\text{CH-COOH}$
 (c) $\text{ClCH}_2\text{-COOH}$
 (d) $\text{CH}_3\text{-COOH}$

a

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

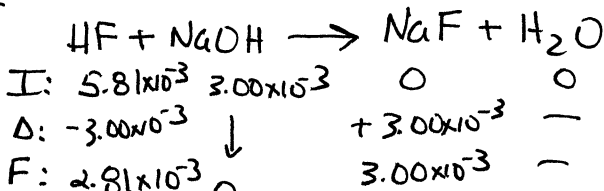
$$0.05050 \text{ L} \times 0.115 \frac{\text{mol}}{\text{L}} = 5.81 \times 10^{-3} \text{ mol HF}$$

$$0.025 \text{ L} \times 0.1200 \frac{\text{mol}}{\text{L}} = 3.00 \times 10^{-3} \text{ mol NaOH}$$

b

5. The entropy of the universe is _____.

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

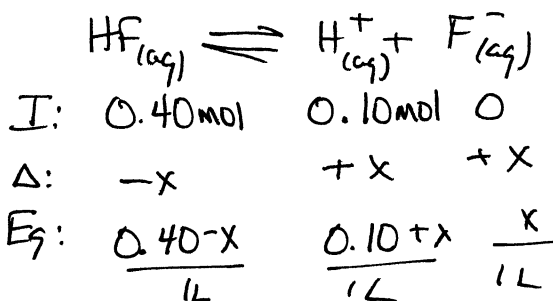


$$6.8 \times 10^{-4} = \frac{[\text{H}^+](3.00 \times 10^{-3})}{2.81 \times 10^{-3}}$$

c

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



$$6.8 \times 10^{-4} = \frac{(x)(0.10+x)}{(0.40-x)}$$

$$x = 2.72 \times 10^{-3}$$

$$[\text{H}^+] = 0.103 \text{ M}$$

b

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 PbI₂ least soluble?

- (a) H₂O
(b) 1.0 M HNO₃
(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 ΔG° (in kJ) at this temperature?

- (a) 1.8**
(b) -4.2
(c) 4.2
(d) 1.5 x 10²

$$\Delta G^\circ = -RT \ln K$$
$$= -(8.314 \frac{\text{J}}{\text{mol}\cdot\text{K}})(298 \text{ K}) \ln 0.48$$

11. Determine the pH of a solution prepared by dissolving 0.75 mol of NH₃ and 0.25 mol of NH₄Cl in a liter of solution (K_b for NH₃ is 1.8 x 10⁻⁴).

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

$$\text{pH} = \text{p}K_a + \log \frac{[\text{base}]}{[\text{acid}]}$$
$$= -\log \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-4}} + \log \frac{0.75}{0.25}$$
$$= 10.26$$

12. Which one of the following reactions would have a positive value for ΔS°?

- (a) Ba(OH)₂(s) + CO₂(g) → BaCO₃(s) + H₂O(l)
(b) N₂(g) + 3 H₂(g) → 2 NH₃(g)
(c) 2 SO₃(g) → 2 SO₂(g) + O₂(g)
(d) AgNO₃(aq) + HCl(aq) → AgCl(s) + HNO₃(aq)

13. CFC stands for _____.

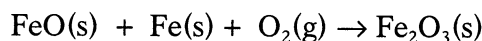
- (a) chlorinated freon compound
(b) caustic fluorine carbohydrate
 (c) chlorofluorocarbon
(d) carbonated fluorine compound

14. Consider the titration of 25.0 mL of 0.723 M HClO₄ with 0.273 M KOH. The H⁺ concentration before any KOH is added is _____ M.

- (a) 0.439
(b) 1.00 x 10⁻⁷
(c) 2.81 x 10⁻¹³
 (d) 0.723

$$\boxed{0.723 \text{ M H}^+}$$
$$\text{pH} = -\log [\text{H}^+] = -\log 0.723$$

15. Consider the reaction:



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

Substance	ΔH_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 ₂ O ₃ (s)	-822.16	89.96

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

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

$$0 = -550.26 \times 10^3 \text{ J} - (T)(-202.94 \text{ J/K})$$

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

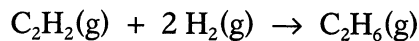
- (a) NaOH
(b) KC₂H₃O₂
 (c) HF
(d) NaF

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

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

$$K_{sp} = 8.0 \times 10^{-28} = [Pb^{2+}][S^{2-}]$$

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



Substance	S° (J/mol-K)
-----------	---------------------

$C_2H_2(g)$	200.8
$H_2(g)$	130.58
$C_2H_6(g)$	229.5

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

$$\Delta S^\circ = [(229.5)] - [200.8 + 2(130.58)]$$

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
- (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?

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

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

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

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

- (a) H₂
 (b) C₂H₂
 (c) CH₄
 (d) C₂H₆

d

23. Consider the titration of 50.0 mL of 0.217 M HN₃ (K_a = 2.6 × 10⁻⁵) with 0.183 M NaOH. Calculate the pH of the solution after addition of 59.3 mL of NaOH solution.

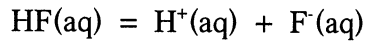
- (a) 2.61
 (b) 8.79
 (c) 12.21
 (d) 4.59

b

$$0.050 \text{ L} \times 0.217 \frac{\text{mol}}{\text{L}} = 0.01085 \text{ mol HN}_3$$

$$0.0593 \text{ L} \times 0.183 \frac{\text{mol}}{\text{L}} = 0.01085 \text{ mol NaOH}$$

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



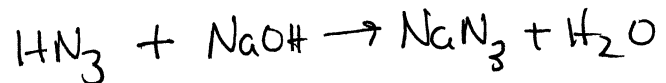
- (a) The concentration of H⁺ will increase significantly.
 (b) The concentration of F⁻ will increase as will the concentration of H⁺.
 (c) The concentration of HF will decrease and the concentration of F⁻ will increase.
 (d) The concentration of F⁻ will decrease and the concentration of HF will increase.

d

25. Which of the following is the STRONGEST acid?

- (a) CH₄
 (b) NH₃
 (c) H₂O
 (d) HF

d



$$\text{I: } 0.01085 \quad 0.01085$$

Δ:

F:



$$\frac{0.01085 \text{ mol}}{0.1093 \text{ L}}$$

