

READ THESE DIRECTIONS CAREFULLY BEFORE STARTING THE EXAMINATION!

It is *extremely* important that you fill in the answer sheet EXACTLY as indicated, otherwise your test may not be processed; ALL entries are to be made on SIDE 1 of the answer sheet. Use a #2 pencil (or softer); fill in the circles completely and firmly. Erasures must be complete. Use only the following categories:

NAME:	Print your name starting at the first space, LAST NAME first, then a space, followed by your FIRST NAME, then another space, followed by your MIDDLE INITIAL. Fill in the <u>correct</u> circles below your printed name corresponding to the letters of your name; for the spaces, fill in the top blank circle.						
STUDENT NUMBER:	This is VERY IMPORTANT! Under IDENTIFICATION NUMBER, put in your 8 DIGIT STUDENT ID NUMBER (do not use the 9 at the beginning of your number) beginning in column A and continuing through column H, column I will be blank, (do NOT use column J at this time); be sure to fill in the correct circles (a common error to be avoided is mistaking "0" for "1").						
TEST FORM:	Fill in the "4" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination IV).						
SPECIAL CODES:	Use for course and section number; in positions K-P write in one of the following: <div style="text-align: center;"> <table> <tr> <td>Dr. Woodrum</td> <td>107-001, 107-002</td> </tr> <tr> <td>Mr. Harris</td> <td>107-003, 107-004</td> </tr> <tr> <td>Dr. Ades</td> <td>107-401</td> </tr> </table> </div>	Dr. Woodrum	107-001, 107-002	Mr. Harris	107-003, 107-004	Dr. Ades	107-401
Dr. Woodrum	107-001, 107-002						
Mr. Harris	107-003, 107-004						
Dr. Ades	107-401						
SIGNATURE:	You MUST sign the examination answer sheet (bubble sheet) on the line directly above your printed name. Use your legal signature.						

Answering Questions:

Starting with answer "1" on SIDE 1, fill in the circle indicating the one best answer for each of the **60 questions** in this examination. Your score is the sum of the appropriate credit for each response.

Grading and Reporting:

The examination scores will be posted in Blackboard as soon as possible after the examination. If an error has been made in scoring your answers, tell your instructor within 48 hours of the posting of your score.

<p><u>BE SURE THAT YOUR TEST HAS 60 QUESTIONS, A PERIODIC TABLE, AND TWO SHEETS OF SCRATCH PAPER.</u> You may <u>NOT</u> use your own scratch paper during this examination. Cell phones and pagers are to be turned off and out of sight during the exams.</p>
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5. Nickel crystallizes in a face-centered cubic structure with a density of 9.02 g/cm^3 . What is the edge length of the unit cell?

A. 164 pm

C. 221 pm

B. 329 pm

D. 351 pm

6. Which one of the following solutes would you expect to be **most** soluble in benzene (C_6H_6)?

A. CH_3OH

C. CO_2

B. NaF

D. PF_3

7. Which of the following statements is **true**?

A. The solubility of a solid in water always decreases with increasing temperature.

B. The solubility of a gas in water decreases with increasing temperature.

C. The solubility of a gas in water increases with decreasing pressure.

D. The solubility of an ionic solid in water always decreases with increasing temperature.

8. What is the molality of a solution prepared by dissolving 194 g of HCl in enough water to form 525 mL of solution? The density of the solution is 1.20 g/mL .

A. 12.2 m

C. 8.49 m

B. 37.0 m

D. 23.3 m

9. Commercial grade hydrochloric acid solutions are typically 39.0% (by mass) HCl in water. What is the molarity of this solution? The density of the solution is 1.20 g/mL .

A. 7.79 M

C. 12.8 M

B. 10.7 M

D. 9.35 M

10. A solution containing 42.55 mg of an unknown protein per 15.0 mL solution was found to have an osmotic pressure of 4.65 mm Hg at 25°C. What is the molar mass of the protein?

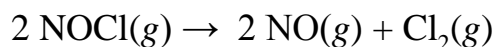
A. 8.79×10^6 g/mol

C. 4.41×10^4 g/mol

B. 7.26×10^5 g/mol

D. 1.13×10^4 g/mol

11. What is the rate of formation of Cl_2 at the time that NO is being formed at a rate of 4.84×10^{-2} M/s in the following reaction?



A. 4.84×10^{-2} M/s

C. 1.45×10^{-1} M/s

B. 2.42×10^{-2} M/s

D. 9.68×10^{-2} M/s

12. The decomposition of XY is second order in XY and has a rate constant of $7.02 \times 10^{-3} \text{ M}^{-1} \cdot \text{s}^{-1}$. How long, in minutes, will it take for the concentration of XY to decrease to 25.0% of its initial concentration when the initial concentration is 0.10 M?

A. 71 min

C. 4.9×10^3 min

B. 1.5 min

D. 82 min

13. In an Arrhenius plot of the $\ln k$ versus $1/\text{temperature}$ in K, the slope of the straight line is $-5.60 \times 10^3 \text{ K}$ and the y-intercept is 22.72. What is the frequency factor for the reaction?

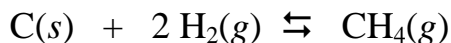
A. 7.36×10^9

C. 4.66×10^4

B. 5.25×10^{22}

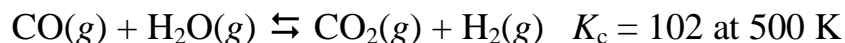
D. 1.35×10^{-10}

-
18. At a high temperature, solid carbon was introduced into a container filled with $\text{H}_2(\text{g})$ at 1.000 atm pressure. When the reaction below reached equilibrium, the partial pressure of $\text{CH}_4(\text{g})$ was 0.138 atm. What is K_p for the reaction at the same temperature?



- A. 0.263
B. 0.186
C. 0.138
D. 7.25

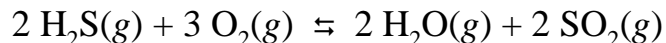
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19. Consider the reaction:



If the mixture initially contains 0.150 M CO_2 and 0.150 M H_2 , what will be the equilibrium concentration of CO ?

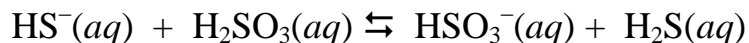
- A. 0.150 M
B. 0.0932 M
C. 0.156 M
D. 0.0135 M

-
20. Consider the following reaction at equilibrium. What effect will increasing the pressure of the reaction mixture have on the system?



- A. The reaction will shift to the left in the direction of the reactants.
B. No effect will be observed.
C. The reaction will shift to the right in the direction of products.
D. The equilibrium constant will increase.
-

21. Which of the following pairs both act as Brønsted-Lowry acids in the reaction below?



- A. $\text{HS}^-(aq)$ and $\text{H}_2\text{SO}_3(aq)$ C. $\text{H}_2\text{SO}_3(aq)$ and $\text{H}_2\text{S}(aq)$
B. $\text{H}_2\text{SO}_3(aq)$ and $\text{HSO}_3^-(aq)$ D. $\text{HSO}_3^-(aq)$ and $\text{H}_2\text{S}(aq)$
-

22. Calculate the concentration of hydroxide in a solution that contains 3.9×10^{-4} M hydronium ion at 25°C . Identify the solution as acidic, basic or neutral.

- A. 2.6×10^{-11} M, acidic C. 3.9×10^{-4} M, neutral
B. 2.6×10^{-11} M, basic D. 2.7×10^{-2} M, basic
-

23. What is the pH of a solution which is 0.0456 M HNO_3 and 0.0422 M HF?
 K_a (of HF) = 3.5×10^{-4} .

- A. 1.34 C. 1.79
B. 2.46 D. 2.08
-

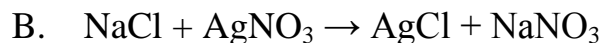
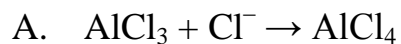
24. Which of the following gives an acidic salt, basic salt, and neutral salt in aqueous solution, respectively?

- A. NH_4Br , NaNO_3 , AlCl_3 C. CaCO_3 , FeCl_3 , BaCl_2
B. $\text{CH}_3\text{NH}_3\text{Cl}$, KNO_2 , NaI D. NaCl , NaNO_3 , NH_4Cl
-

25. Identify the weakest acid.

- A. HF C. H_2O
B. HCl D. NH_3
-

26. Which one of the following is not a Lewis acid-base reaction?



27. Determine the pH of a buffer formed by adding 15.0 mL of 0.100 M HF with 20.0 mL of 0.115 M NaF. $K_a(\text{HF}) = 3.5 \times 10^{-4}$.

A. 3.64

C. 3.46

B. 2.89

D. 2.25

28. What is the pH of 1.00-L of an aqueous solution that is 0.750 M in CH_3NH_2 and 0.500 M in $\text{CH}_3\text{NH}_3\text{Cl}$ after the addition of 0.0250 mol HCl to the solution?
 K_b for $\text{CH}_3\text{NH}_2 = 4.4 \times 10^{-4}$.

A. 10.50

C. 10.64

B. 10.85

D. 10.78

29. Which of the following buffer solutions will be able to neutralize the most added HCl before losing buffer capacity?

A. 0.05 M NaOCl and 0.20 M HOCl

C. 0.20 M NaOCl and 0.10 M HOCl

B. 0.05 M NaOCl and 0.15 M HOCl

D. 0.10 M NaOCl and 0.10 M HOCl

30. A 100.0 mL sample of 0.18 M HClO_4 is titrated with 0.27 M LiOH. Determine the pH of the solution after the addition of 30.0 mL of LiOH.

A. 0.86

C. 2.10

B. 1.21

D. 1.12

Questions 31 – 45 cover material from Exam 3

31. Determine the molar solubility of MgCO_3 in pure water. $K_{\text{sp}}(\text{MgCO}_3) = 6.82 \times 10^{-8}$.

- A. $6.82 \times 10^{-6} \text{ M}$ C. $4.65 \times 10^{-4} \text{ M}$
B. $3.41 \times 10^{-6} \text{ M}$ D. $2.61 \times 10^{-4} \text{ M}$

32. What is the solubility of Ag_3PO_4 in an aqueous $0.0500 \text{ M Na}_3\text{PO}_4$ solution?
 $K_{\text{sp}}(\text{Ag}_3\text{PO}_4) = 8.89 \times 10^{-17}$.

- A. $4.04 \times 10^{-6} \text{ M}$ C. $2.10 \times 10^{-8} \text{ M}$
B. $2.98 \times 10^{-8} \text{ M}$ D. $1.31 \times 10^{-5} \text{ M}$

33. Which of the following salts is more soluble in acid than in water?

- A. NH_4NO_3 C. $\text{Ca}(\text{NO}_3)_2$
B. NaCl D. CaCO_3

34. A solution containing CaCl_2 is mixed with a solution of $\text{Li}_2\text{C}_2\text{O}_4$ to form a solution that is $2.1 \times 10^{-5} \text{ M}$ in calcium ion and $4.75 \times 10^{-5} \text{ M}$ in oxalate ion. What will happen once these solutions are mixed? $K_{\text{sp}}(\text{CaC}_2\text{O}_4) = 2.3 \times 10^{-9}$.

- A. A precipitate will form since $Q > K_{\text{sp}}$ for calcium oxalate.
B. No precipitate will form since $Q < K_{\text{sp}}$ for calcium oxalate
C. Nothing will happen since calcium oxalate is extremely soluble.
D. Nothing will happen since $K_{\text{sp}} = Q$ and the solution is saturated.
-

35. A solution is prepared by mixing 0.015 mol of NiCl_2 into a 200.0-mL sample of a solution that is 0.550 M in NH_3 . After the solution reaches equilibrium, what concentration of $\text{Ni}^{2+}(\text{aq})$ remains? $K_f(\text{Ni}(\text{NH}_3)_6^{2+}) = 2.0 \times 10^8$.

- A. 1.3 M
B. 3.8×10^{-4} M
C. 3.3×10^{-9} M
D. 0.075 M

36. Which one of the following statements is **true**?

- A. A spontaneous reaction always occurs rapidly.
B. Spontaneity can depend on temperature.
C. Processes that are spontaneous always occur at an observable rate.
D. A positive $\Delta S_{\text{surroundings}}$ guarantees that a process is spontaneous.

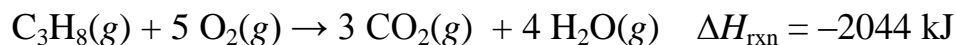
37. For an endothermic reaction, the entropy of the universe can only increase if

- A. the reaction has a positive entropy change.
B. the reaction has a negative entropy change.
C. the second law of thermodynamics is violated.
D. the products are less disordered than the reactants.

38. Which of the following has the most positive ΔS_{sys} ?

- A. $2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{SO}_3(\text{g})$
B. $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
C. $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow 2 \text{NaCl}(\text{aq}) + \text{BaSO}_4(\text{s})$
D. $4 \text{NH}_3(\text{g}) + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{N}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{g})$
-

-
39. The following reaction is carried out at 450 °C. Determine the entropy change of the surroundings.

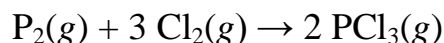


- A. 459 J/K
B. 2830 J/K
C. -442 J/K
D. -2790 J/K

-
40. Which one of the following is **false** at constant temperature and pressure?

- A. ΔG is proportional to the negative of $\Delta S_{\text{universe}}$.
B. $\Delta G < 0$ represents a spontaneous process.
C. $\Delta S_{\text{sys}} < 0$ always represents a nonspontaneous process.
D. Changes in free energy (ΔG) can be computed solely with respect to the system of interest.

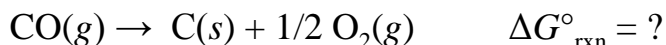
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41. From the thermochemical data below, calculate the entropy change for the reaction



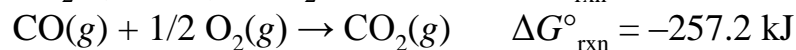
	ΔH° (kJ/mol)	ΔG° (kJ/mol)	S° (J/K•mol)
$\text{P}_2(g)$	144.0	103.5	218.1
$\text{Cl}_2(g)$	0	0	223.1
$\text{PCl}_3(g)$	-287.0	-267.8	311.8

- A. -263.8 J/K
B. -129.4 J/K
C. -29.4 J/K
D. 1511 J/K
-

42. Calculate $\Delta G^\circ_{\text{rxn}}$ for the reaction



using the following information.



A. -60.0 kJ

C. -265.8 kJ

B. 651.6 kJ

D. 137.2 kJ

43. ΔG of a reaction is considered to be the maximum of the useful energy that can be obtained from a reaction. What name is given to a reaction that achieves less than the theoretical limit with respect to available free energy?

A. Complicated reaction

C. Irreversible reaction

B. Reversible reaction

D. Independent reaction

44. Consider the following reaction at 298 K:



What is ΔG_{rxn} when the partial pressure of SO_2 is 855 mm Hg, the partial pressure of O_2 is 459 mm Hg, and the partial pressure of SO_3 is 4980 mm Hg.

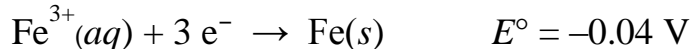
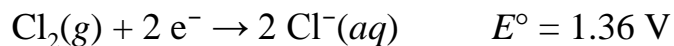
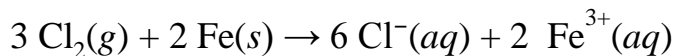
A. -132 kJ

C. -137 kJ

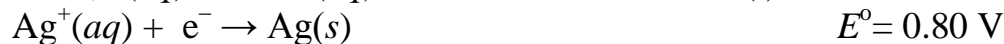
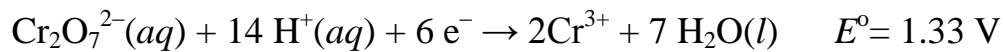
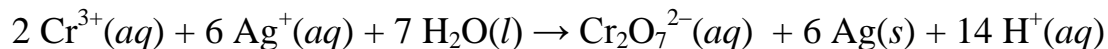
B. -152 kJ

D. -167 kJ

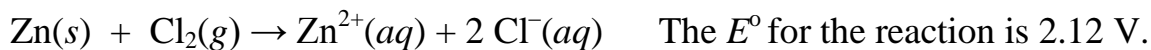
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48. Use the standard electrode potentials listed below to calculate the standard cell potential for the following reaction occurring in an electrochemical cell at 25°C.



- A. 4.16 V
B. -1.40 V
C. -1.32 V
D. 1.40 V
-
49. Using the standard electrode potentials provided, determine ΔG° for the following reaction at 25 °C.



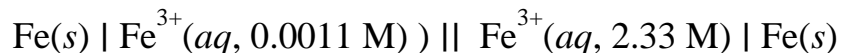
- A. -2.0 kJ
B. 310 kJ
C. 51 kJ
D. -225 kJ
-
50. A voltaic cell employs the following redox reaction:



Calculate the cell potential when $[\text{Zn}^{2+}] = 0.500 \text{ M}$; $[\text{Cl}^-] = 0.0500 \text{ M}$ and $P_{\text{Cl}_2} = 1.25 \text{ atm}$.

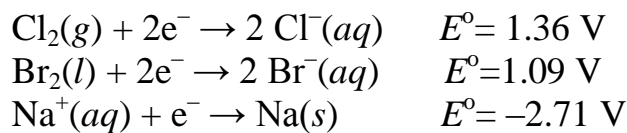
- A. 2.21 V
B. 2.16 V
C. 2.30 V
D. 2.06 V
-

-
51. Calculate the cell potential for the following reaction that takes place in an electrochemical cell at 25°C.



- A. 0.00 V
B. -0.036 V
C. 0.066 V
D. -0.099 V

-
52. Given the following standard electrode potentials. What products are obtained in the electrolysis of a molten mixture of NaCl and NaBr?

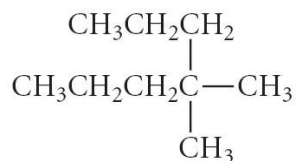


- A. Na only
B. Na and Cl₂
C. Na and Br₂
D. Na, Cl₂ and Br₂

-
53. How many minutes will it take to plate out 8.00 g of gold from a AuCl₃ solution using a current of 4.00 A?

- A. 32.7 min
B. 87.1 min
C. 126 min
D. 49.0 min
-

54. Name the following compound:



- A. 4-methyl-4-propylpentane C. nonane
B. 4,4-dimethylheptane D. 4-propyl-4-methylpentane
-

55. Which of the following is optically active?

- A. $\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{CH}_3 \\ | \\ \text{OH} \end{array}$ C. $\text{CH}_3\text{CHClCH}_3$
B. $\text{CHBr}_2\text{CH}_2\text{CH}_2\text{Br}$ D. $\text{CH}_3\text{CH}_2\text{CBr}_2\text{CH}_3$
-

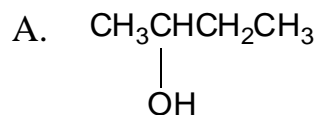
56. What (is)are the product(s) for the addition of HBr to $\text{CH}_2=\text{CHCH}_2\text{CH}_3$?

- A. $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ C. $\text{CH}_3\text{Br} + \text{CH}_2\text{BrCH}_2\text{CH}_3$
B. $\text{CH}_4 + \text{CHBr}_2\text{CH}_2\text{CH}_2\text{Br}$ D. $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{CH}_3$
-

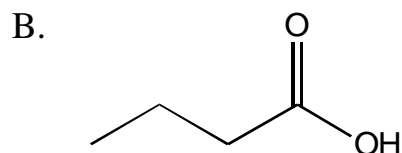
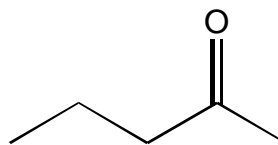
57. Which of the following is an ester?

- A. $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{CH}_2\text{CNH}_2 \end{array}$ C. $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{C}-\text{OH} \end{array}$
B. $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{CH}_2\text{CCH}_3 \end{array}$ D. $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{CH}_2\text{C}-\text{O}-\text{CH}_3 \end{array}$
-

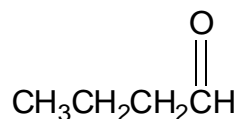
58. Which of the following is an aldehyde?



C.



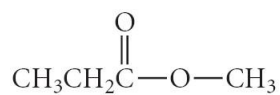
D.



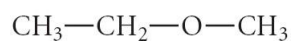
59. Which of the following is the main product of the reaction of $\text{CH}_3\text{CH}_2\text{COOH}$ with CH_3OH ?



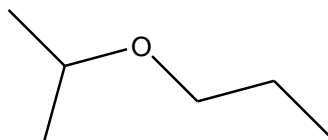
C.



D.



60. Name the following:



A. Butyl propanoate

C. Isopropyl propanoic acid

B. Isopropyl propyl ether

D. Ethyl isopropyl ether

CHE 107 SPRING 2011 Final Exam Key

1. C
2. D
3. B
4. B
5. D
6. C
7. B
8. A
9. C
10. D
11. B
12. A
13. A
14. A
15. C
16. C
17. B
18. A
19. D
20. C
21. C
22. A
23. A
24. B
25. D
26. B
27. A
28. D
29. C
30. D
31. D
32. A
33. D
34. B
35. B
36. B
37. A
38. D
39. B
40. C
41. A
42. D
43. C
44. A
45. C
46. C
47. B
48. D
49. B
50. A

- 51. C
- 52. C
- 53. D
- 54. B
- 55. A
- 56. A
- 57. D
- 58. D
- 59. C
- 60. B