

University of Kentucky

Department of Chemistry

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 "3" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination III).
SPECIAL CODES:	Use for course and section number; in positions K-P write in one of the following: Dr. Ades 107-001, 107-002
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 **25 questions** in this examination. Your score is the sum of the appropriate credit for each response. The day after the examination is finished, an examination key will be posted on Blackboard.

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.

BE SURE THAT YOUR TEST HAS 25 QUESTIONS, A PERIODIC TABLE, AND ONE SHEET OF SCRATCH PAPER. You may NOT use your own scratch paper during this examination. Cell phones and pagers are to be turned off and out of sight during the exams.

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1. K_p for the reaction below is 0.0121 at some temperature. Initially 1.00 atm of PCl_5 , 1.0 atm of PCl_3 , and 1.00 atm of Cl_2 are placed in a container and allowed to come to equilibrium. Which of the following statements are true for the reaction at equilibrium?



1. The pressure of $\text{PCl}_5(g)$ in the container will be 3.00 atm.
2. The pressure of $\text{Cl}_2(g)$ will be less than 1.00 atm.
3. The total pressure in the container will be less than 3.00 atm.
4. The total pressure in the container will be greater than 3.00 atm.

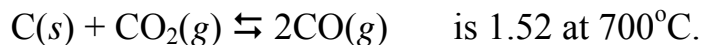
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|------------|------------|
| A. 1 and 2 | C. 3 and 4 |
| B. 2 and 3 | D. 1 and 4 |

-
2. Initially $\text{NH}_4\text{HS}(s)$ was placed in a reaction vessel. Once equilibrium was reached at 22°C , the total gas pressure for the reaction below was found to be 0.52 atm. What is K_p for the reaction at 22°C ? (Some $\text{NH}_4\text{HS}(s)$ remains at equilibrium.)



- | | |
|----------|--------|
| A. 0.27 | C. 1.0 |
| B. 0.068 | D. 3.7 |

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3. K_p for the reaction



What is the equilibrium partial pressure, in torr, of $\text{CO}_2(g)$ when the partial pressure of $\text{CO}(g)$ is 255 torr?

- | | |
|-------------------------------|--------------|
| A. 7.41×10^{-2} torr | C. 168 torr |
| B. 135 torr | D. 56.3 torr |
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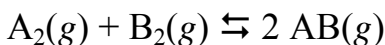
4. At equilibrium, the pressure of the reacting mixture



is 1829 mmHg at 950°C. What is K_p for the reaction at 950°C?

- A. $K_p = 5.47 \times 10^{-4}$ C. $K_p = 0.416$
B. $K_p = 1829$ D. $K_p = 2.41$
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5. At some temperature, $K = 16.0$ for the following reaction:



Initially 2.00 mol of $\text{A}_2(g)$ and 2.00 mol of $\text{B}_2(g)$ are placed in a 1.00 L reaction vessel. What is the concentration of $\text{AB}(g)$ when the reaction has come to equilibrium?

- A. 1.78 M C. 2.67 M
B. 1.33 M D. 3.56 M
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6. Nitrosyl bromide (NOBr) decomposes according to :



A 0.64 mol sample of NOBr was placed in a 1.00 L flask containing no NO or Br_2 . At equilibrium the flask contained 0.46 mol of NOBr. How many moles of NO and Br_2 are in the flask at equilibrium?

- A. 0.090 mol NO, 0.18 mol Br_2 C. 0.18 mol NO, 0.18 mol Br_2
B. 0.18 mol NO, 0.090 mol Br_2 D. 0.090 mol NO, 0.090 mol Br_2
-

7. Which of the following equilibria will shift to the product side in response to a decrease in volume at constant temperature?

1. $\text{C}(s) + \text{O}_2(g) \rightleftharpoons \text{CO}_2(g)$
2. $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$
3. $4\text{Fe}(s) + 3\text{O}_2(g) \rightleftharpoons 2\text{Fe}_2\text{O}_3(s)$
4. $2\text{SO}_3(g) \rightleftharpoons 2\text{SO}_2(g) + \text{O}_2(g)$

- A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 4

8. The equilibrium constant, K_p , for the reaction $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$ is 360 at 400 K and 0.10 at 500 K. Which of the following statements are **true**?

1. The reaction is endothermic
2. Adding $\text{He}(g)$ at constant volume forces the reaction to the left.
3. Increasing the temperature shifts the reaction to the reactant side.
4. The equilibrium partial pressure of $\text{NH}_3(g)$ is greater at 400 K than at 500 K.

- A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 4

9. Which of the following are conjugate acid/base pairs?

1. $\text{H}_2\text{SO}_4/\text{HSO}_4^-$
2. $\text{OH}^-/\text{O}^{2-}$
3. $\text{NH}_4^+/\text{NH}_2^-$
4. $\text{H}_2\text{PO}_4^-/\text{PO}_4^{3-}$

- A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 4
-

10. K_w for water at 50 °C is 5.476×10^{-14} . Which of the following statements are **true** for pure water at 50 °C?

1. pH=7.3692
2. Pure water is acidic at 50 °C
3. pOH = 6.6308
4. $[\text{H}_3\text{O}^+](aq) = [\text{OH}^-](aq)$

- A. 1 and 2
B. 2 and 3
- C. 3 and 4
D. 1 and 4

11. What is the **hydroxide** concentration in a solution whose pH = 12.58?

- A. $2.6 \times 10^{-13} M$
B. $5.8 \times 10^{-11} M$
- C. $3.8 \times 10^{-2} M$
D. $2.6 \times 10^{-1} M$

12. What mass of $\text{Ba}(\text{OH})_2$ is needed to prepare 5.00×10^2 ml of a solution whose pH is 12.00. The molar mass of $\text{Ba}(\text{OH})_2$ is 171.3 g/mol.

- A. 0.214 g
B. 0.856 g
- C. 1.71 g
D. 0.428 g

13. What is the pH of a solution that is 0.050 M in HNO_3 and 0.008 M in HBr ?

- A. 1.30
B. 2.10
- C. 3.40
D. 1.24

14. The pH of a 0.00500 M solution of a weak monoprotic acid was determined to be 2.650. What is K_a for the acid?

- A. 1.81×10^{-3}
B. 1.00×10^{-3}
- C. 7.12×10^{-4}
D. 5.30×10^2
-

15. What is the pH of a 0.075 M aniline ($\text{C}_6\text{H}_5\text{NH}_2$) solution. $K_b = 3.8 \times 10^{-10}$ for aniline.

A. 10.54

C. 5.27

B. 8.73

D. 3.45

16. In which of the following is the **stronger** acid listed **first**?

1. HCl, HF

2. HOF, HOCl

3. PH_3 , H_2S

4. HNO_2 , HNO_3

A. 1 and 2

C. 3 and 4

B. 2 and 3

D. 1 and 4

17. Which of the following have a pH > 7 when dissolved in water?

1. NaCN

2. BaI_2

3. $\text{CH}_3\text{NH}_3\text{Cl}$

4. Na_2S

A. 1 and 2

C. 3 and 4

B. 2 and 3

D. 1 and 4

18. Which oxide will have the **lowest** pH when dissolved in water? All are 0.01 M in concentration.

A. Al_2O_3

C. BaO

B. SO_3

D. MgO

19. What is the pH of an aqueous $5.5 \times 10^{-2} M$ NaNO_2 (sodium nitrite) solution?
 $K_a = 4.5 \times 10^{-4}$ for nitrous acid (HNO_2).

- A. 5.96
B. 2.30

- C. 11.70
D. 8.04

20. Which of the following act as Lewis bases?

1. $\text{C}_5\text{H}_5\text{N}$
2. H_2O
3. AlF_3
4. $\text{B}(\text{OH})_3$

- A. 1 and 2
B. 2 and 3

- C. 3 and 4
D. 1 and 4

21. Which of the following are true for buffer systems?

1. A buffer is an aqueous solution of two weak bases.
2. A buffer can absorb unlimited amounts of acid or base without large fluctuations in pH.
3. A buffer does not significantly change pH when small amounts of acid or base are added.
4. A buffer can be prepared from a solution of a weak acid and a salt that contains the conjugate base of the acid.

- A. 1 and 2
B. 2 and 3

- C. 3 and 4
D. 1 and 4

22. What is the pH of 100. ml of a solution that contains $0.15 M$ HOCl and $0.75 M$ NaOCl .
The K_a for HOCl is 2.9×10^{-8} .

- A. 8.24
B. 6.84

- C. 7.54
D. 4.12
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23. Which of the following aqueous solutions, when mixed together, can form a buffer solution?

1. NH_3 and HCl
2. H_3PO_4 and NaH_2PO_4
3. HCl and KOH
4. HCN and HNO_3

- A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 4

24. Which of the following aqueous solutions will have the **highest** pH?

- A. 0.10 M HNO_2
B. 0.10 M HNO_2 and 0.10 M NaNO_2
C. 0.10 M HNO_2 and 0.10 M $\text{Ca}(\text{NO}_2)_2$
D. 0.10 M HNO_2 and 0.10 M NaCl

25. Which of the following buffer systems are the best choices to prepare a buffer with pH= 9.0?

1. $\text{NH}_3/\text{NH}_4\text{Cl}$ $K_b = 1.8 \times 10^{-5}$ for NH_3
2. HOBr/NaOBr $K_a = 2.8 \times 10^{-9}$ for HOBr
3. $\text{C}_5\text{H}_5\text{N}/\text{C}_5\text{H}_5\text{NHCl}$ $K_b = 1.7 \times 10^{-9}$ for $\text{C}_5\text{H}_5\text{N}$
4. $\text{C}_6\text{H}_5\text{COOH}/\text{C}_6\text{H}_5\text{COOK}$ $K_a = 6.5 \times 10^{-5}$ for $\text{C}_6\text{H}_5\text{COOH}$

- A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 1 and 4
-

