

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 "2" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination 2).
SPECIAL CODES:	Use for course and section number; in positions K-P write in one of the following: <div style="text-align: center;"> Dr. Allison Soult 107001 and 107002 Dr. Lisa Blue 107003 and 107006 Dr. H. Ades 107005 </div>
SIGNATURE:	You MUST sign the examination answer sheet (bubble sheet) on the line directly above your printed name. Use your legal signature.

Answering Questions:

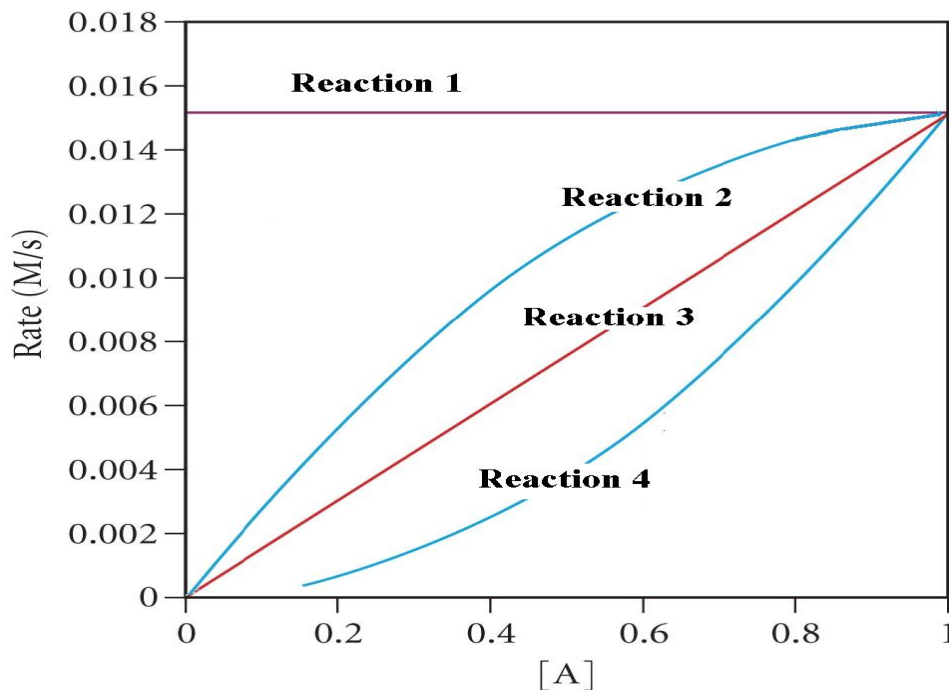
Starting with answer "1" on SIDE 1, fill in the circle indicating the one best answer for each of the 30 questions in this examination. Your score is the sum of the appropriate credit for each response. Soon after the examination is finished, an examination key will be posted on Blackboard.

Grading and Reporting:

The examination scores will be posted in Blackboard within 96 hours 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 30 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.

4. According to the plot below, which of these reactions demonstrates zero-order kinetics?



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

5. The decomposition of azomethane at 300°C follows first order kinetics. If the initial concentration of $\text{CH}_3\text{N}_2\text{CH}_3(g)$ is 0.400 M, how much remains after 240 s?



- A. 0.217 M
B. 0.157 M
C. 0.324 M
D. 0.0523 M

6. The rate constant for the second-order reaction, $2 \text{NO}_2 \rightarrow 2 \text{NO} + \text{O}_2$, is $0.345 \text{ M}^{-1} \text{ s}^{-1}$. Starting with a concentration of 0.250 M, what is the NO_2 concentration after 30.0 minutes?

- A. 0.0625 M
B. 0.237 M
C. 0.00160 M
D. 0.00930 M
-

7. What is the half-life for the first-order radioactive decay of radium-223 if 1.26 g of an initial 25.0 g sample of radium-223 remains after 50.0 days?

- A. 10.0 days
B. 35.0 days
C. 1.25 days
D. 11.6 days

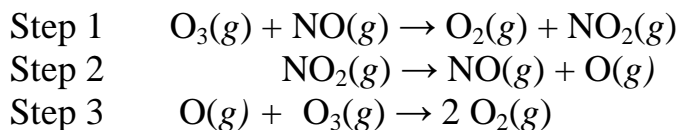
8. Which of the following statement is **true** regarding the effect of temperature on the rate constant, k ?

- A. Increasing the temperature reduces the number of effective collisions between reactants.
B. Decreasing the temperature increases the frequency factor, A .
C. Increasing the temperature increases the rate constant.
D. Decreasing the temperature increases the number of molecules that can overcome the activation barrier, E_a .

9. A reaction has an activation energy of 32.6 kJ/mol. By what factor does the rate constant increase when the temperature is raised from 25°C to 50 °C?

- A. 2.8
B. 9.4
C. 1.4
D. 3.5

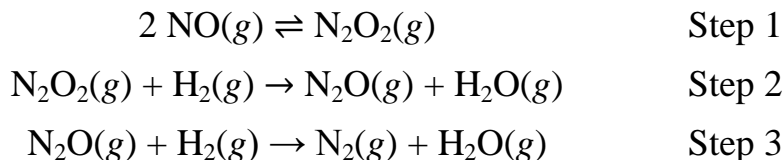
10. The following mechanism has been proposed for a reaction.



Which one of the following is the reaction intermediate in the proposed mechanism?

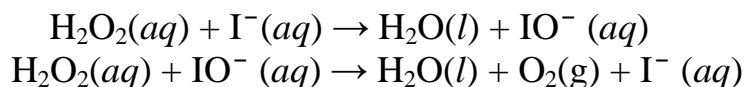
- A. $\text{O}_3(g)$
B. $\text{NO}(g)$
C. $\text{NO}_2(g)$
D. $\text{O}_2(g)$
-

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11. Given the balanced chemical equation and the experimental rate law, $\text{Rate} = k[\text{H}_2][\text{NO}]^2$, determine which is the slow, or rate-determining step, in the proposed mechanism:



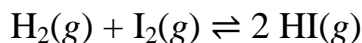
- A. Step 1
B. Step 2
C. Step 3
D. The slow step cannot be determined from the information given.
-

12. Identify the catalyst in the following mechanism:



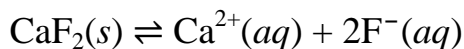
- A. H_2O_2
B. IO^-
C. I^-
D. O_2
-

13. The reaction below has reached a state of dynamic equilibrium. Which one of the following statements about this reaction is **false**?



- A. The rate for the forward reaction is equal to the rate of the reverse reaction.
B. The concentration of $\text{H}_2(g)$ must equal the concentration of $\text{HI}(g)$.
C. The forward and reverse reactions are still occurring.
D. The concentrations of reactants and product remain constant.
-

14. What is the equilibrium constant expression for the following reaction?



A. $K_c = \frac{[\text{Ca}^{2+}][\text{F}^{-}]^2}{[\text{CaF}_2]}$

C. $K_c = [\text{Ca}^{2+}][2\text{F}^{-}]$

B. $K_c = [\text{Ca}^{2+}][\text{F}^{-}]^2$

D. $K_c = \frac{[\text{CaF}_2]}{[\text{Ca}^{2+}][\text{F}^{-}]^2}$

15. The equilibrium constant, K , for the reaction $\text{A}(g) \rightleftharpoons \text{B}(g)$ is 0.20. A 1.0-L reaction vessel initially contains 6.0 mol of B and no A. When equilibrium is reached, which one of the following statements is true? The temperature is constant.

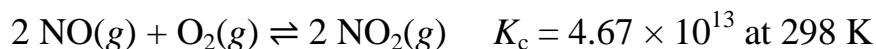
A. The reaction mixture will contain 3.0 mol of A and 3.0 mol of B.

B. The reaction mixture will contain 4.0 mol of A and 2.0 mol of B.

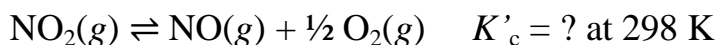
C. The reaction mixture will contain 1.0 mol of A and 5.0 mol of B.

D. The reaction mixture will contain 5.0 mol of A and 1.0 mol of B.

16. Given



what is the equilibrium constant for the reaction shown below?



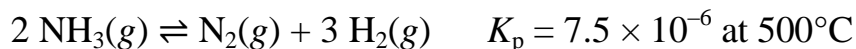
A. 3.28×10^{-14}

C. 1.59×10^{-12}

B. 2.32×10^{-4}

D. 1.46×10^{-7}

17. Gaseous NH_3 decomposes into gas phase nitrogen and hydrogen. If the value of K_p is found to be 7.5×10^{-6} at 500°C , what is the value of K_c ?



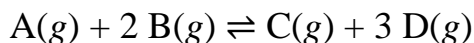
A. 4.6×10^{-9}

C. 0.012

B. 1.9×10^{-9}

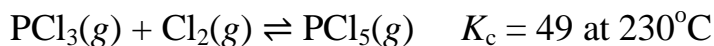
D. 0.030

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18. Initially 3.00 mol of A(g) and 3.00 mol of B(g) are placed in a 1.0-L reaction vessel. At equilibrium 1.50 mol D(g) had formed. What is K_c for the reaction below?



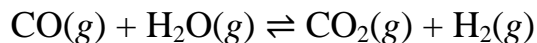
- A. 6.67 C. 0.450
B. 1.50 D. 0.169
-

19. Which way will the reaction proceed given the following initial concentrations:
[PCl₃] = 0.0290 M, [Cl₂] = 0.240 M, [PCl₅] = 0.258 M?



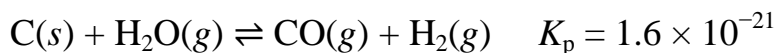
- A. To the left because $Q < K$ C. To the right because $Q < K$
B. To the left because $Q > K$ D. To the right because $Q > K$
-

20. A reaction mixture initially contains 0.100 M CO and 0.100 M H₂O. What is the final concentration of CO₂ in the reaction below? The equilibrium constant is 23.2 for the reaction.



- A. 0.100 M C. 0.0949 M
B. 0.0828 M D. 0.0175 M
-

21. Initially 24.0 g C(s) and 3.00 atm of H₂O(g) were injected into a reaction vessel at 298 K and allowed to react until the equilibrium below was established.



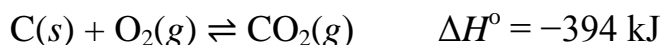
What is the pressure of CO(g) at equilibrium?

- A. 2.2×10^{-19} atm C. 5.5×10^{-10} atm
B. 4.7×10^{-12} atm D. 6.9×10^{-11} atm
-

22. If the reaction $5 \text{CO}(g) + \text{I}_2\text{O}_5(s) \rightleftharpoons \text{I}_2(g) + 5 \text{CO}_2(g)$ is at equilibrium, which way will the reaction proceed when the volume decreases?

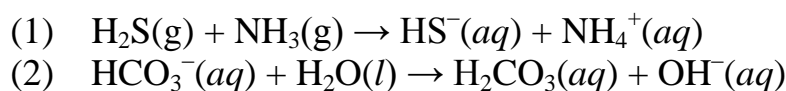
- A. Towards the products.
- B. Towards the reactants.
- C. Volume changes will not affect equilibrium.
- D. Temperature also needs to change for the equilibrium to shift.

23. The following reaction is initially at equilibrium. Which of the following will increase the mass of $\text{CO}_2(g)$ formed once equilibrium is reestablished?



- A. adding more $\text{C}(s)$
- B. removing $\text{O}_2(g)$
- C. adding $\text{He}(g)$ at constant volume
- D. decreasing the temperature

24. Select the **reactants** from each balanced chemical equation below that function as Brønsted-Lowry acids.



- A. (1) H_2S ; (2) H_2O
- B. (1) H_2S ; (2) HCO_3^-
- C. (1) NH_3 ; (2) H_2O
- D. (1) NH_3 ; (2) HCO_3^-

25. Which one of the following 0.100 M acids has the highest percent ionization?

- A. HNO_2 , $K_a = 4.6 \times 10^{-4}$
 - B. HCHO_2 , $K_a = 1.8 \times 10^{-4}$
 - C. HCN , $K_a = 4.9 \times 10^{-10}$
 - D. $\text{HC}_6\text{H}_5\text{O}$, $K_a = 1.3 \times 10^{-10}$
-

26. K_w for water is 1.14×10^{-15} at 0°C . Which of the following statements about water at 0°C is false?

- A. $[\text{OH}^-] = 1.15 \times 10^{-8} \text{ M}$ for pure water
- B. $\text{pH} + \text{pOH} = 14.94$
- C. $\text{pH} = 7.47$ for a neutral solution
- D. $[\text{H}^+] = 3.38 \times 10^{-8} \text{ M}$ for pure water

27. A solution is 0.075 M in HNO_3 and 0.010 M in hydrocyanic acid, HCN . What is the pH of this solution? K_a for HCN is 4.9×10^{-10} .

- A. 6.65
- B. 2.32
- C. 4.90
- D. 1.12

28. Find the pH of a 0.250 M HClO solution which has a K_a of 2.9×10^{-8} .

- A. 5.43
- B. 4.07
- C. 8.46
- D. 7.62

29. A 0.068 M solution of a weak base has a pH of 10.50. What is K_b for the base?

- A. 4.6×10^{-4}
- B. 1.5×10^{-6}
- C. 2.2×10^{-5}
- D. 2.4×10^{-7}

30. Which of the following is **not** a conjugate acid-base pair?

- A. $\text{H}_2\text{SO}_4, \text{SO}_4^{2-}$
 - B. $\text{HNO}_2, \text{NO}_2^-$
 - C. $\text{NH}_3, \text{NH}_4^+$
 - D. $\text{HPO}_4^-, \text{H}_2\text{PO}_4$
-

CHE 107 SPRING 2013 Exam 2 Key

1. D
2. C
3. C
4. A
5. A
6. C
7. D
8. C
9. A
10. C
11. B
12. C
13. B
14. B
15. D
16. D
17. B
18. D
19. C
20. B
21. D
22. B
23. D
24. A
25. A
26. A
27. D
28. B
29. B
30. A