**Summer 2003**

# CHEMISTRY 115

## EXAM 2(A)

1. The reaction 2A→B+C was found to second order in the concentration of A. What is the change in the reaction rate, Rate(t)/Rate(0), in the time interval from 0 to *t* if the concentration of A decreases by a factor of two, [A(t)]/[A(0)] = 0.5?

   A. 0.5

   B. 1.

   C. 2.

   D. 0.25

2. The rate constant for a particular reaction is 1.3 x $10^{-4}$ $M^{-1}s^{-1}$ at 200 K. What is the overall order of the reaction?

   A. 0

   B. 1

   C. 2

   D. 3

3. A first-order reaction has the rate constant of 0.3 $s^{-1}$. Determine the time it takes to decrease the reactant concentration from 0.6 M to 0.3 M

   A. 2.3 s

   B. 5.5 s

   C. 2.0 s

   D. 6.0 s

4. As the temperature of the reaction increases, the rate of the reaction increases because

   A. the reacting molecules collide less frequently

   B. activation energy is lowered

   C. reacting molecules collide with greater energy per collision

   D. the equilibrium constant decreases

5. The sketch shown below allows one to calculate the frequency factors and activation energies of two reaction (1 and 2) from the temperature dependence of their corresponding rate constants. From this calculation, one gets:

   A. $A_1 > A_2$, $E_{a,1} > E_{a,2}$

   B. $A_1 > A_2$, $E_{a,1} < E_{a,2}$

   C. $A_1 < A_2$, $E_{a,1} > E_{a,2}$

   D. $A_1 < A_2$, $E_{a,1} < E_{a,2}$

6. Using the sketch shown below calculate the activation energy of the reverse reaction

   A. 20 kJ/mol

   B. 40 kJ/mol

   C. 60 kJ/mol

   D. 80 kJ/mol

7. On the sketch below identify the point indicating the intermediate state:

   A. A

   B. B

   C. C

   D. D

8. The mechanism for the formation of product X is:

   $A + B \rightarrow C + D$

   $B + D \rightarrow X$

   Indicate the intermediate for this reaction:

   A. C

   B. D

   C. B

   D. X

9. A catalyst increases the reaction rate by

   A. decreasing heat of the reaction

   B. lowering the activation barrier

C. changing the equilibrium constant

D. increasing the activation barrier of the reverse react

10. What is the conjugate base of $HSO_3^-$?

A. $H_2SO_3$

B. $OH^-$

C. $SO_3^{2-}$

D. $H_3O^+$

11. Using the table of relative strength of acid-base pairs below identify the products of the reaction

$OH^- + HS^-$

A. $S^{2-} + H_2O$

B. $H_2S + O^{2-}$

C. $H_2O$

D. $HSO_3^-$

12. The molar concentration of hydroxide in pure water at 25 $^oC$ is:

A. 1

B. 0

C. $1 \times 10^{-14}$

D. $1 \times 10^{-7}$

13. What is the pH of 0.015 M solution of barium hydroxide ($Ba(OH)_2$). [Hint: beware of stoichiometry for $OH^-$]?

A. 12.48

B. 12.18

C. 1.52

D. 10.35

14. The concentration of nitric acid with a pH of 4.39 is

A. 0.012 M

B. 0.64 M

C. $2.5 \times 10^{-4}$ M

D. $4.1 \times 10^{-5}$ M

15. The $K_a$ of HF is $6.8 \times 10^{-4}$. What is the pH of a 0.35 M solution of HF?

A. 1.81

B. 3.17

C. 0.46

D. 3.62

16. Calculate the pH of a 0.5 M aqueous solution of $NH_3$. The $K_b$ of $NH_3$ is $1.8 \times 10^{-5}$.

A. 4.4

B. 12.09

C. 8.95

D. 11.48

17. For a given acid $K_a$ is equal $4 \times 10^{-4}$. What is $pK_b$ for this acid?

A. 6.3

B. 13.1

C. 5.4

D. 10.6

18. Indicate which of the salts listed below will produce a basic solution

A. NaCl

B. NaClO

C. $NH_4Cl$

D. $Na_2SO_4$

19. B is a week base. Which equilibrium corresponds to the acid ionization constant $K_a$ for $HB^+$?

A. $HB^+(aq) + H_2O(l) \leftrightarrow B(aq) + H_3O^+$

B. $HB^+(aq) + H_3O^+(aq) \leftrightarrow H_2B^{2+}(aq) + H_2O(l)$

C. $B(aq) + H_2O(l) \leftrightarrow HB^+(aq) + OH^-(aq)$

D. $B(aq) + H_3O^+(aq) \leftrightarrow HB^+(aq) + H_2O(l)$

20. $K_a$ for HX is $7.5 \times 10^{-12}$. What is the pH of 0.15 M solution of NaX?

A. 7.87

B. 12.15

C. 8.03

D. 5.97

**Summer 2003**

# CHEMISTRY 115

## EXAM 2(B)

1. The reaction 2A→B+C was found to second order in the concentration of A. What is the change in the reaction rate, Rate(t)/Rate(0), in the time interval from 0 to *t* if the concentration of A decreases by a factor of two, [A(t)]/[A(0)] = 0.5?

   E. 2.

   F. 1.

   G. 0.5

   H. 0.25

2. The rate constant for a particular reaction is $1.3 \times 10^{-4}$ $M^{-1}s^{-1}$ at 200 K. What is the overall order of the reaction?

   E. 1

   F. 0

   G. 3

   H. 2

3. A first-order reaction has the rate constant of 0.3 $s^{-1}$. Determine the time it takes to decrease the reactant concentration from 0.6 M to 0.3 M

   E. 5.5 s

   F. 2.3 s

   G. 6.0 s

   H. 2.0 s

4. As the temperature of the reaction increases, the rate of the reaction increases because

   E. activation energy is lowered

   F. the reacting molecules collide less frequently

   G. the equilibrium constant decreases

   H. reacting molecules collide with greater energy per collision

5. The sketch shown below allows one to calculate the frequency factors and activation energies of two reaction (1 and 2) from the temperature dependence of their corresponding rate constants. From this calculation, one gets:

   E. $A_1 < A_2$, $E_{a,1} > E_{a,2}$

   F. $A_1 > A_2$, $E_{a,1} < E_{a,2}$

   G. $A_1 < A_2$, $E_{a,1} > E_{a,2}$

   H. $A_1 < A_2$, $E_{a,1} < E_{a,2}$

6. Using the sketch shown below calculate the activation energy of the reverse reaction

   E. 40 kJ/mol

   F. 20 kJ/mol

   G. 80 kJ/mol

   H. 60 kJ/mol

7. On the sketch below identify the point indicating the intermediate state:

   E. D

   F. C

   G. B

   H. A

8. The mechanism for the formation of product X is:

   $A + B \rightarrow C + D$

   $B + D \rightarrow X$

   Indicate the intermediate for this reaction:

   E. D

   F. C

G. X

H. B

9. A catalyst increases the reaction rate by

E. changing the equilibrium constant

F. increasing the activation barrier of the reverse reaction

G. decreasing heat of the reaction

H. lowering the activation barrier

10. What is the conjugate base of $HSO_3^-$?

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F. $H_2S + O^{2-}$

G. $S^{2-} + H_2O$

H. $HSO_3^-$

12. The molar concentration of hydroxide in pure water at 25 $^oC$ is:

E. $1 \times 10^{-14}$

F. $1 \times 10^{-7}$

G. 1

H. 0

13. What is the pH of 0.015 M solution of barium hydroxide ($Ba(OH)_2$)? [Hint: beware of stoichiometry for $OH^-$]

E. 10.35

F. 1.52

G. 12.18

H. 12.48

14. The concentration of nitric acid with a pH of 4.39 is

E. $2.5 \times 10^{-4}$ M

F. $4.1 \times 10^{-5}$ M

G. 0.012 M

H. 0.64 M

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17. For a given acid $K_a$ is equal $4 \times 10^{-4}$. What is $pK_b$ for this acid?

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G. 10.6

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18. Indicate which of the salts listed below will produce a basic solution

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F. NaCl

G. $NH_4Cl$

H. $Na_2SO_4$

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G. $HB^+(aq) + H_3O^+(aq) \leftrightarrow H_2B^{2+}(aq) + H_2O(l)$

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