Jordan University of Science & Technology
Department of Applied Chemical Sciences
CH 102 Final Exam
13/06/2009

Student's Name: **Instructor:**
Student's No.: **Section:** **Serial No.:**

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***** *Each of the question bellow is followed by four suggested answers. Select the one that is best in each case and type it in the above table.*

1. The pH of a 1 x 10^{-10} M HCl(aq) is approximately equal to --------.
   A. 10.0 B. 4.0 C. 7.0 D. 5.0

Consider the following ionization constants of some weak acids for the next 2 questions:

Acid	K_a
CH_3COOH	1.8 x 10^{-5}
HF	7.1 x 10^{-4}
HCN	4.9 x 10^{-10}
HNO_2	4.5 x 10^{-4}
NH_4^+	5.6 x 10^{-10}

2. Which of the following is the **strongest base**?
   A. NH_3 B. F^- C. CH_3COO^- D. CN^-

3. Predict the direction of the following reaction in aqueous solution

   $$HNO_2(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + NO_2^-(aq)$$

   A. The net reaction will shifted to the **left** favoring HNO_2 and CN^-
   B. In the **middle**
   C. The net reaction will shifted to the **right** favoring HCN and NO_2^-
   D. Can not be determined

4. What is the **original molarity** (initial concentration) of a solution of a monoprotic acid (HA) whose pH is 2.44 at equilibrium? (K_a HA = 2.64 x 10^{-4})
   A. 13.8 M B. 0.05 M C. 20 M D. 0.10 M

5. The K_w for water at **0ºC** is 1.6 x 10^{-15}. What is the pH and pOH of water at **0ºC**?
   A. pH = pOH = 7.0 B. pH = 6.6, pOH = 7.4
   C. pH = pOH = 7.4 D. pH = 7.4, pOH = 6.6

6. Which one of the following solutions would be expected to have the **highest % ionization**?
   A. 0.1 M HF B. 0.05 M HF C. 1.0 M HF D. 5.0 M HF

7. At 25ºC what is the pH of a 1.75 M solution of NaCN? (K_a HCN = 4.9 x 10^{-10})
   A. 11.78 B. 10.88 C. 3.44 D. 1.18

Good Luck

8. Water can not function as which one of the following?
A. a Bronsted acid B. a Bronsted Base C. a Lewis acid D. a Lewis base

9. Which one of the following compounds is the **strongest acid**?
A. $HClO_3$ B. $HClO_2$ C. HClO D. $HClO_4$

10. An aqueous solution of $NaHSO_3$ will be _____. (K_{a1} = 1.7 x 10^{-2}, K_{a2} = 6.4 x 10^{-8})
A. neutral B. acidic C. Basic D. non

11. H_3PO_4 has the following ionization constants: K_{a1} = 7.5 x 10^{-3}, K_{a2} = 6.2 x 10^{-8}, K_{a3} = 4.8 x 10^{-13}. To make up a buffer solution of pH 7.21. Which of the following combination would you choose?
A. $H_2PO_4^-$/ HPO_4^{-2} B. $H_3PO_4/H_2PO_4^-$ C. HPO_4^{-2}/PO_4^{-3} D. H_3PO_4/KOH

12. Calculate the pH of 1.0 L of the buffer 0.30 M CH_3CO_2H/0.36 M CH_3CO_2Na after the addition of 0.1 mole of HCl? (K_a for CH_3CO_2H = 1.8 x 10^{-5}) Assume that the volume of the solution does not change when the HCl is added.
A. 4.82 B. 4.38 C. 5.11 D. 4.56

13. Addition NH_4Cl, to a NH_3 solution_____.
A. increases the pH of the solution B. decreases the pH of the solution
C. increases the concentration of OH^- D. has no effect on the pH of the solution

14. Which of the following statements is **correct**?
A. At equilibrium the reaction is completely stopped
B. At equilibrium the rate constant for the forward reaction equals that of the reverse reaction
C. At equilibrium there are equal amounts of reactants and products
D. At equilibrium the forward and the reverse reactions are occurring at the same rate

15. Consider the following reaction at equilibrium: A(g) ⇌ 2 B(g). Based on the following data, which of the following is **correct?**

Temperature (ºC)	[A]	[B]
200	0.0125	0.843
300	0.171	0.764
400	0.250	0.724

A. the reaction is exothermic. B. the reaction is endothermic.
C. K_c at 200ºC > K_c at 300ºC. D. $K_p = K_c$

16. At 430ºC, the equilibrium constant (K_c) for the reaction:

$$H_2 + I_2 \rightleftharpoons 2\ HI$$

is 64. If you start with $[H_2]$ = 0.08 M, $[I_2]$ = 0.08 M and [HI] = 0.64 M, what are the concentrations of HI, H_2, and I_2 **at equilibrium**?

A.	$[H_2]$ = 0.08 M	$[I_2]$ = 0.08 M	[HI] = 0.64 M
B.	$[H_2]$ = 0.04 M	$[I_2]$ = 0.04 M	[HI] = 0.32 M
C.	$[H_2]$ = 0.32 M	$[I_2]$ = 0.32 M	[HI] = 0.24 M
D.	$[H_2]$ = 0.015 M	$[I_2]$ = 0.015 M	[HI] = 0.12 M

17. For the reaction: 2 A(g) + 3 B_2(g) ⇌ 2 AB_3(g)
An increase in pressure would ---------.
A. increase the value of the equilibrium constant, K_c
B. shift the reaction to form more reactants (from Right to Left)
C. shift the reaction to form more products (from Left to Right)
D. no affect equilibrium

Good Luck

18. The standard free energy change for the dissociation of silver chromate is +66.2 kJ/ mol at 25°C.

$$Ag_2CrO_4(s) \rightleftharpoons 2\ Ag^+(aq) + CrO_4^{2-}(aq)$$

What is the $[Ag^+]$ ions in the solution if the $[CrO_4^{2-}]$ ions at the equilibrium is 2.0×10^{-3} M?

A. 1.2×10^{-9} M B. 6.2×10^{-7} M C. 3.5×10^{-5} M D. 3.5×10^{-4} M

19. Consider the equilibrium $AB_2(aq) \rightleftharpoons A(aq) + 2\ B(aq)$
Suppose you start with 0.2 M of AB_2 in a 1.0 L flask at 500 K. Calculate K_c for the equilibrium at the same temperature if the equilibrium concentration of B is 0.1 M.

A. 1.0×10^{-2} B. 3.33×10^{-3} C. 5.0×10^{-4} D. 2.5×10^{-3}

20. Which of the following will be present in the smallest concentration in an aqueous 0.025 M H_2CO_3 solution? ($K_{a1} = 4.3 \times 10^{-7}$, $K_{a2} = 5.6 \times 10^{-11}$)

A. H_2CO_3 B. H_3O^+ C. HCO_3^- D. CO_3^{2-}

21. The **incorrect** statement about the catalyst effect is ------.
A. increases the rate of reaction
B. changes the mechanism of the reaction
C. lowers the activation energy
D. increases the value of the equilibrium constant

22. The molarity of pure water is ----------. (water density is 1.0 g/ml)

A.5.55 M B. 55.5 M C. 1000 M D. 1.0 M

23. Calculate the boiling point of an aqueous solution of a nonvolatile solute that freezes at – 3.4 °C.
(for H_2O :$K_b = 0.52$ °C/*m*, $K_f = 1.86$ °C/*m*)

A. 100 .95 °C B. 100 .84 °C C. 100.52 °C D. 100.31 °C

24. Which of the species below exhibits hydrogen bonding?

A. CH_3-S-CH_3 B. CH_3OCH_3 C. CH_3OH D. CH_3SH

25. The three Laws of the thermodynamics are as follows:
I. The total ------- of the universe is constant.
II. The total --------- of the universe increases for a spontaneouse process.
III. The ---------- of a perfectly ordered crystal at 0 K is 0.
The answers in order are ----------.

A. energy, energy, energy B. energy, entropy, energy
C. energy, entropy, entropy D. entropy, energy, entropy

26. Calculate ΔG° for the following reaction,

$$N_2(g) + 3\ H_2O(l) \rightarrow 2\ NH_3(g) + 3/2\ O_2(g)$$

given that $\Delta G°_f[H_2O(l)] = -237.1$ kJ/mol and $\Delta G°_f\ [NH_3(g)] = -16.5$ kJ/mol.

A. 221 kJ B. 678 kJ C. -221 kJ D. 348 kJ

27. Use the information below to determine the value of the rate constant for the following reaction:

$$A + B \rightarrow P$$

Experiment	[A], M	[B], M	Rate, M/s
1	0.273	0.763	2.83
2	0.273	1.526	2.83
3	0.819	0.763	25.47

A. 38.0 B. 0.278 C. 13.2 D. 42.0

28. Consider the following reaction at 25°C: $C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$
If $\Delta G° = 91.2$ KJand $\Delta S° = 135$ J/K, what is the value of $\Delta H°$ for this reaction at 25°C?

A. 40.3 kJ B. 226 kJ C. 91.3 kJ D. 131.4 kJ

Good Luck

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