Chemistry 110 Section 3

Practice Exam 4 (Ch 7[Rate&Equilibrium], 8, and 9)

Note:
1.   Sit according to the seat number assigned (ask the TA or the instructor).
2.   Use a softhead pencil, fill in you name, z-number, department name (CHEM), course name (110), and today's date () in the scantron sheet.
3.   Use the following Periodic Table for the problems involving atomic mass and group names in this exam.
4.   This is a **close-book** exam. You **cannot** use your textbook or notes. However, you should use a calculator. **Cell phones are not allowed during the exam**. The following data may be helpful to you.

Avogadro's number: N_A = 6.022 x 10^{23} = 1 mole
Gas constant R = 0.0821 L atm/(mol K)
pH definition: $pH = -\log[H_3O^+]$, $[H_3O^+] = 10^{-pH}$
Water ion-product constant $K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$
Acid-Base titration equation $n_H(M_{acid})(V_{acid}) = n_{OH}(M_{base})(V_{base})$
$\Delta G° = \Delta H° - T\Delta S°$
q= (amt)(ΔT) (Specific heat)

Periodic Table of the Elements:

Choose the most appropriate answer.

1. Which of the following will not affect the rate of a reaction:
A. Equilibrium constant
B. Concentration of reactants
C. Temperature of reactants
D. Physical state of reactants
E. Presence of a catalyst

2. For the following reaction 2A + B → 3D, it was determined the reaction was first order with respect to A and second order with respect to B, the correct general rate law for this reaction would be:
A. rate=k[A][B]
B. rate=k[A]^2[B]
C. rate=k[A][B]^2
D. rate=k[A]^3[B]^3
E. rate=k

3. The rate law for a reaction is: rate=k [I]^2. If the concentration of [I] is doubled, the rate will
A. increase 2-fold
B. increase 4-fold
C. decrease 2-fold
D. decrease 4-fold
E. not change

4. The rate law for a reaction is: rate=k [A]. If the concentration of [A] is halved, the rate will
A. increase 2-fold
B. increase 4-fold
C. decrease 2-fold
D. decrease 4-fold
E. not change

5. Which energy difference in the energy profile below corresponds to $\Delta H°$?
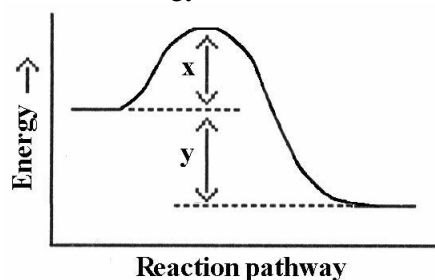
A. x+y
B. x-y
C. x÷y
D. x
E. y

6. At equilibrium of the following reaction, the concentration of dinitrogen tetroxide is 0.022 M and the concentration of nitrogen dioxide is 0.010. Calculate the value of the equilibrium constant (K_{eq}). $2NO_2$ (g) ↔ N_2O_4 (g)

A. 0.022
B. 1.0
C. 4.5 x 10^{-3}
D. 2.2 x 10^2
E. 2.2 x 10^4

7. What is the equilibrium constant expression for the following reaction $2NH_3$ (g) ⇌ N_2 (g) + $3H_2$ (g)

A. $\dfrac{[N_2][H_2]^2}{[NH_3]^3}$
B. $\dfrac{[N_2][H_2]^3}{[NH_3]^2}$

C. $\dfrac{[NH_3]^2}{[N_2][H_2]^3}$
D. $\dfrac{[NH_3]}{[N_2][H_2]}$
E. None of the above

8. Write the equilibrium expression for the following reaction: $CaCO_3$ (s) ⇌ Ca^{2+}(aq) + CO_3^{2-}(aq)

A. $\dfrac{[Ca^{2+}][CO_3^{2-}]}{[CaCO_3]}$
B. $[Ca^{2+}][CO_3^{2-}]$

C. $\dfrac{[Ca^{2+}]^2[CO_3^{2-}]^2}{[CaCO_3]}$
D. $[Ca^{2+}]^2[CO_3^{2-}]^2$
E. None of the above

9. A reaction was determined to have an equilibrium constant $K=1 \times 10^{16}$. The reaction can be described as being favored to the _____; the concentration of products is relatively _____.
A. the left; small   B. the right; large   C. the right; small
D. the left; large   E. neither direction; large

10. Given this equilibrium: $2NH_3(g) + heat \rightleftharpoons N_2(g) + 3H_2(g)$, which action will increase the relative number of moles of N_2 present at equilibrium?
A) heating the equilibrium mixture   B) adding a catalyst.
C) adding hydrogen to the reaction chamber   D) decreasing the volume of the reaction chamber
E) removing NH_3 from the mixture

11. Given the equilibrium system: $Pb^{2+}(aq) + CO_3^{2-}(aq) \rightleftharpoons PbCO_3(s)$, after equilibrium, addition of $CO_3^{2-}(aq)$:
A) causes no effect
B) causes the amount of $PbCO_3(s)$ to decrease, and the $Pb^{2+}(aq)$ concentration to decrease
C) causes the amount of $PbCO_3(s)$ to increase, and the $Pb^{2+}(aq)$ concentration to decrease
D) causes the amount of $PbCO_3(s)$ to increase, and the $Pb^{2+}(aq)$ concentration to increase
E) causes the amount of $PbCO_3(s)$ to decrease, and the $Pb^{2+}(aq)$ concentration to increase

12. What is the $[H_3O^+]$ in a solution with $[OH^-] = 1 \times 10^{-8}$ M?
A) 1×10^2 M   B) 1×10^{-6} M   C) 1×10^{-8} M   D) 1×10^{-7} M   E) 1×10^{-5} M

13. What is the pH of a solution with $[H_3O^+] = 3.1 \times 10^{-10}$ M?
A) -9.51   B) 4.7×10^{-7} M   C) 9.51   D) 7.98   E) 10.8

14. In which of the following are the pH values arranged from the most acidic to the most basic?
A) 7, 10, 14, 4, 3, 1   B) 14, 10, 7, 4, 3, 1   C) 2, 5, 7, 9, 14, 11   D) 14, 10, 7, 1, 3, 5   E) 1, 3, 6, 8, 11, 14

15.   What is the pH of a 0.20 M HCl solution?
A.) < 0   B) 0.70   C). 1.61   D). 12.39   E.) 13.30

16. What is the $[OH^-]$ for a solution at 25°C that has $[H_3O^+] = 8.23 \times 10^{-2}$ M?

A) > 10^{-5} M B) 1.22×10^{-6} M C) 8.23×10^{-12} M D) 1.22×10^{-13} M E) 8.23×10^{-16} M

17.   Select the pair of substances which is not a conjugate acid-base pair.

A) H_3O^+, H_2O B) HNO_2, NO_2^- C) H_2SO_4, HSO_4^-
D) H_2S, S^{2-} E) NH_3, NH_2^-

18.   Select the pair of substances in which an acid is listed followed by its conjugate base.

A) H^+, HCl   B) NH_3, NH_4^+ C) HPO_4^{2-}, $H_2PO_4^-$
D) HCO_3^-, CO_3^{2-} E) CH_3COOH, $CH_3COOH_2^+$

19. A strong acid dissociation reaction will react _____, and will be expected to have a _____ equilibrium

constant
A. partially; large   B. Completely; small   C. partially; small   D. Completely; large
E. partially; intermediate

20) In which of the following are the pH values arranged from the most acidic to the most basic?
A) 7, 10, 14, 4, 3, 1   B) 14, 10, 7, 4, 3, 1   C) 2, 5, 7, 9, 14, 11   D) 14, 10, 7, 1, 3, 5   E) 1, 3, 6, 8, 11, 14

21) Which of the following is a neutralization reaction?
A) $C + O_2 \rightarrow CO_2$ B) $H_2SO_4 + 2LiOH \rightarrow Li_2SO_4 + 2H_2O$
C) $2NO_2 \rightarrow 2NO + O_2$ D) $4Na + O_2 \rightarrow 2Na_2O$ E) $AgNO_3 + HCl \rightarrow AgCl + HNO_3$

22) What are the spectator ions in the reaction $HNO_3 + KOH \rightarrow \square KNO_3 + H_2O$?
A) K^+ and NO_3^- B) H_2O C) HNO_3 D) KOH   E) H^+ and OH^-

23) In a buffer system of HF and its salt, NaF,
A) F^- neutralizes added base.   B) HF neutralizes added acid   C) HF is not necessary.
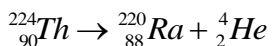D) F^- neutralizes added acid.   E) F^- neutralizes added Na^+.

24) Which statement about nuclear reactions is true?
A) The rate of a nuclear reaction is increased by the addition of a catalyst.
B) Energy changes in nuclear reactions are much greater than in ordinary chemical reactions.
C) Nuclear reactions do not change in the nucleus of an atom.
D) A nuclear reaction is the same no matter what isotope is used
E) Nuclear reactions normally do not occur at very low temperature
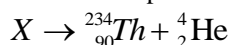
25) Which is the best description of a beta particle?
A) charge 0; mass of 0 amu; high penetrating power   B) charge +2; mass of 4 amu; low penetrating power
C) charge -1; mass of 0 amu; medium penetrating power   D) charge +1; mass of 0 amu; high penetrating power
E) charge +2; mass of 4 amu; high penetrating power

26) The nuclear reaction shown below is an example of what type of process?
$$^{224}_{90}Th \rightarrow ^{220}_{88}Ra + ^{4}_{2}He$$
A) alpha emission   B) fission   C) beta emission   D) fusion   E) translation

27) What is the unknown isotope X in the following nuclear reaction?
$$X \rightarrow ^{234}_{90}Th + ^{4}_{2}He$$
A) alpha particle   B) beta particle   C) $^{238}_{90}Th$ D) $^{238}_{92}Th$ E) $^{238}_{92}U$

- **end** -
(Sign and write down your seat number in the back of the scantron. Hand in the scantron and keep this copy for your record)