AP Chemistry Final Exam
Version J
Spring 2005

36 Multiple Choice questions, 45 minutes

NO CALCULATORS MAY BE USED. You will have a periodic table.

Note: For all questions, assume that the temperature is 298 K, the pressure is 1.00 atmospheres, and solutions are aqueous unless otherwise specified.

Guessing: One-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.

You may write on this exam; however, you will only be given credit for answers recorded on the Scantron sheet.

NAME:

PERIOD: 5   6   7

April 28, 2005

SCORE: _____   -   _____/4   =   _____
           Correct   Incorrect   Overall

          _____
          Blank

Version J

1. Which of the following compounds is most likely to have the largest van't Hoff factor, i?
   A. NaCl
   B. NH_4NO_3
   C. Na_2SO_4
   D. Sucrose
   E. $Ni(OH)_2$

2. The initial concentration of reactant A in a second-order reaction is 0.20 M. The rate constant for the reaction is 0.60 s^{-1}. What is the concentration of reactant A after 5 s?
   A. ln [A] = - 0.60(5) + ln (0.20)
   B. ln [A] = 0.60(5) + ln (0.20)
   C. 1 / [A] = - 0.60(5) + 1 / 0.20
   D. 1 / [A] = 0.60(5) + 1 / 0.20
   E. None of the above

3. Consider the chemical reaction: 2 NO (g) + Cl_2 (g) → 2 NOCl (g). What is the rate law?
   A. Rate = k[NO][Cl_2]
   B. Rate = k[NO]^2[Cl_2]
   C. Rate = k[NO][Cl_2]^2
   D. Rate = k[2 NO][Cl_2]
   E. Rate = k^3[NO][Cl_2]

4. Considering the Haber process (the equilibrium production of ammonia), which of the following statements must increase the output of ammonia?

I.	Addition of a catalyst to the system
II.	Decreasing the volume of the system
III.	Increasing the pressure on the system

   A. I only
   B. II only
   C. I and II
   D. I and III
   E. I, II, and III

5. For a certain basic solution, [OH^{1-}] = 1 x 10^{-9}, what is the pH of the solution?
   A. -9
   B. 1
   C. 5
   D. 9
   E. 13

6. Which of the following is a weak acid?

I.	Acetic acid
II.	Hydrofluoric acid
III.	Zn^{2+}

   A. I only
   B. II only
   C. III only
   D. I and II
   E. I, II, and III

7. Which of the following is the solubility-product constant expression for the equilibrium dissociation of cuprous peroxide?
   A. $K_{sp} = [Cu^{2+}][O_2^{2-}]$
   B. $K_{sp} = [2\ Cu^{2+}][2\ O_2^{2-}]$
   C. $K_{sp} = (2[Cu^+]^2)\ (2[O_2^{2-}]^2)$
   D. $K_{sp} = [Cu^+]^2[O_2^{2-}]$
   E. $K_{sp} = 1\ /\ ([Cu^+]^2[O_2^{2-}])$

8. Which of the following chemical reactions has the greatest decrease in entropy?
   A. $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$
   B. $2\ H_2O\ (g) \rightarrow 2\ H_2\ (g) + O_2\ (g)$
   C. $H_2\ (g) + Cl_2\ (g) \rightarrow 2\ HCl\ (g)$
   D. $2\ HCl\ (g) \rightarrow H_2\ (g) + Cl_2\ (g)$
   E. Not enough information is provided.

9. For which of the following is the standard Gibbs free energy of formation <u>and</u> the standard molar entropy equal to zero?
   I. $H_2\ (g)$
   II. $H_2O\ (l)$
   III. $C\ (s,\ diamond)$
   A. I only
   B. II only
   C. III only
   D. II and III
   E. None of the above

10. In the following chemical equation which takes place in acidic solution, how many moles of water are represented?
    $Cr^{3+-}\ (aq) \rightarrow CrO_4^-\ (aq) + Cr\ (s)$

    A. 4
    B. 11
    C. 14
    D. 23
    E. None of the above

11. Which of the following elements is the best reducing agent?
    A. H_2
    B. Li
    C. O_2
    D. Cu
    E. Not enough information.

12. In the electrolysis of water, what is produced at the anode?
    A. Hydrogen
    B. Hydride
    C. Hydroxide
    D. Oxygen
    E. None of the above

13. A neutron fuses with a plutonium-244 nucleus. The product of this nuclear reaction then undergoes beta decay. The product of this decay is:

    A. Americium-244
    B. Americium-245
    C. Neptunium-244
    D. Neptunium-245
    E. None of the above

14. If 150.0 mg of a sample of a radionuclide remains after three half-lives, what was the quantity of the original sample?

    A. 37.50 mg
    B. 50.00 mg
    C. 450.0 mg
    D. 600.0 mg
    E. None of the above

15. Which of the following nitrogen compounds is least likely to form?

    A. Ca_3N_2
    B. K_3N
    C. N_2O_3
    D. N_2O_5
    E. N_2O_7

16. Which of the following is diamagnetic?

    A. Cu
    B. Mn^{2+}
    C. O_2
    D. Sc^{2+}
    E. Zn^{2+}

17. The complex in $[CuBr(NH_3)_3]_3PO_3$:

        I.   Is called triamminebromocopper (I)
        II.   Is called triamminebromocopper (II)
        III.   Has a tetrahedral structure
        IV.   Has a square planar structure

    A. I and III
    B. I and IV
    C. II and III
    D. II and IV
    E. None of the above

18. Which of the following compounds can only be an alkene?

    A. C_3H_8
    B. C_3H_6
    C. C_6H_6
    D. C_2H_6
    E. None of the above

19. What is the value of $(2115 - 2101) \times 10.0 \times 100.0$ with the proper number of significant figures?
    A. 1×10^4
    B. 1.4×10^4
    C. 1.40×10^4
    D. 1.400×10^4
    E. 1.4000×10^4

20. Which of the following statements correctly describes the responses of protons, neutrons, and electrons in a magnetic or electrical field?
    A. Protons and electrons are deflected in opposite directions, but neutrons show no response.
    B. Only protons are deflected, but neutrons and electrons are not affected.
    C. Both protons and neutrons are deflected, but electrons are not affected.
    D. Both electrons and neutrons are deflected, but protons are not affected.
    E. Both protons and electrons are deflected, but neutrons are not affected.

21. An unknown sample has an empirical formula of C_2H_8O. The molecular weight is determined to be 144 g/mol. What is the molecular formula of the compound?
    A. C_2H_8O
    B. $C_4H_{16}O_2$
    C. $C_6H_{24}O_3$
    D. $C_8H_{32}O_4$
    E. None of the above or not enough information has been provided.

22. How many moles of K^+ are present in 400.0 mL of a 1.20 M solution of K_3PO_4?
    A. 0.480 mol
    B. 0.800 mol
    C. 1.44 mol
    D. 1.92 mol
    E. None of the above or not enough information has been provided.

23. Given: $2 S (s) + 3 O_2 (g) \rightarrow 2 SO_3 (g)$ $\Delta H = - 800$ kJ
                    $S (s) + O_2 (g) \rightarrow SO_2 (g)$ $\Delta H = - 300$ kJ

    What is the enthalpy of the combustion of sulfur dioxide, forming sulfur trioxide?
    A. $- 1100$ kJ
    B. $- 500$ kJ
    C. $- 200$ kJ
    D. 200 kJ
    E. None of the above or not enough information has been provided.

24. Based on Hund's rule, which of the following represents the lowest energy arrangement of electrons in the 4d subshell?
    A. One electron in each of four orbitals, all with a spin of ½.
    B. One electron in each of five orbitals, all with a spin of ½.
    C. One electron in each of ten orbitals, all with a spin of ½.
    D. Two electrons in each of four orbitals.
    E. Two electrons in each of five orbitals.

25. How many different principal quantum numbers can be found in the ground-state electron configuration of yttrium?
    A. 2 quantum numbers
    B. 3 quantum numbers
    C. 4 quantum numbers
    D. 5 quantum numbers
    E. None of the above or not enough information has been provided.

26. Going down the alkaline earth group,
    A. Melting points decrease.
    B. Electronegativity increases.
    C. Ionization energies increase.
    D. Ion size decreases.
    E. Atomic radius stays the same.

27. Which of the following represents a square pyramidal molecular geometry?
    A. SF_4
    B. KrF_2
    C. CF_4
    D. XeF_4
    E. ICl_4^{1-}

28. The hybridization of a terminal carbon in $H_2C=C=CH_2$ is:
    A. sp
    B. sp^2
    C. sp^3
    D. sp^2d
    E. A terminal carbon is not hybridized.

29. Assume that the second-period, diatomic molecule X_2 has a bond order of 2, a bond enthalpy of 620 kJ/mol, and a bond length of 1.31 Å. Element Z, also in the second period, has a bond order of 1. Which of the following would best describe the bonding in Z_2?
    A. 750 kJ/mol, 1.10 Å
    B. 750 kJ/mol, 1.50 Å
    C. 530 kJ/mol, 1.10 Å
    D. 530 kJ/mol, 1.50 Å
    E. Cannot be predicted from the given information.

30. Whose is credited with a law describing the partial pressures of gases?
    A. Avogadro
    B. Brown
    C. Dalton
    D. Graham
    E. Van der Waals

31. A 2.0 mol sample of copper (II) sulfide is added to excess hydrochloric acid, and the resulting hydrogen sulfide gas is collected over water. What volume of hydrogen sulfide gas is collected at 30ºC when the atmospheric pressure is 750 mm Hg? (The vapor pressure of water at this temperature is 35 mm Hg.)
    A. (2)(R)(303) / (715 / 760)
    B. (2)(R)(303) / 715
    C. (2)(R)(303) / (750 / 760)
    D. (R)(303) / (715 / 760)
    E. None of the above

32. Which solids are characterized by high melting point and low electrical conductivity?
   A. Covalent network
   B. Ionic
   C. Molecular
   D. Metallic
   E. Both covalent network and ionic

33. As the concentration of a solute in a solution increases, what is the effect on the boiling point and the vapor pressure of the solution?
   A. The boiling point increases and the vapor pressure increases.
   B. The boiling point increases and the vapor pressure decreases.
   C. The boiling point decreases and the vapor pressure increases.
   D. The boiling point decreases and the vapor pressure decreases.
   E. The boiling point decreases and the vapor pressure is unaffected.

Directions: The set of lettered choices below refers to the numbered statements immediately following it. Select the option that best fits each statement. A choice may be used once, more than once, or not at all in the set.

Questions 34-36
   A. $Mg(NO_3)_2$
   B. Na_2O
   C. Ethanal
   D. Cl_2O
   E. $Co_3(PO_4)_2$

34. Forms colored solutions
35. Contains double bonds
36. Forms the strongest acid solution when added to water.