**AP Chemistry Final Exam**
**Version I**
**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 I**

**<u>Directions:</u> 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.**

**<u>Questions 1-3</u>**

A. $Zn(NO_3)_2$
B. $Na_2O$
C. $CH_3OH$
D. $PO_2^{1-}$
E. $NiSO_4$

1. Forms colored solutions
2. Contains double bonds
3. Forms a basic solution

**<u>Directions:</u> Choose the best option for each question or statement.**

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

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

6. An unknown sample has an empirical formula of $C_3H_8O$. The molecular weight is determined to be 240 g/mol. What is the molecular formula of the compound?
   A. $C_3H_8O$
   B. $C_6H_{16}O_2$
   C. $C_9H_{24}O_3$
   D. $C_{12}H_{32}O_4$
   E. None of the above or not enough information has been provided.

7. How many moles of $K^+$ are present in 500.0 mL of a 1.20 M solution of $K_3PO_4$?
   A. 0.600 mol
   B. 0.800 mol
   C. 1.80 mol
   D. 2.40 mol
   E. None of the above or not enough information has been provided.

8. 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.

9. Based on the Pauli exclusion principle, what is the maximum number of electrons that can be present in the fourth shell?
   A. 8
   B. 14
   C. 18
   D. 32
   E. 60

10. How many different principal quantum numbers can be found in the ground-state electron configuration of nickel?
   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.

11. Going down the halogen group,
   A. Melting points increase.
   B. Electron affinities become more negative.
   C. Ionization energies increase.
   D. Ion size decreases.
   E. Atomic radius stays the same.

12. The octet rule is not violated by the central atom in:
   A. $SF_4$
   B. $KrF_2$
   C. $CF_4$
   D. $XeF_4$
   E. $ICl_4^{1-}$

13. 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.

14. 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 3. 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.

15. Whose is credited with a law describing the effusion of gases?
    A. Avogadro
    B. Brown
    C. Gay-Lussac
    D. Graham
    E. Van der Waals

16. 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

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

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

19. Which of the following compounds is most likely to have the largest van't Hoff factor, i?
    A. NaCl
    B. $NH_4NO_3$
    C. $NH_4Cl$
    D. $Na_2SO_4$
    E. Sucrose

20. The initial concentration of reactant A in a first-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

21. 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][$Cl_2$]

22. Considering the Haber process (the equilibrium production of ammonia), which of the following statements must increase the output of ammonia?
    I. Increasing the pressure on the system
    II. Decreasing the volume of the system
    III. Addition of a catalyst to the system

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

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

24. Which of the following is a weak base?
    I. Ammonia
    II. Fluoride
    III. Sodium acetate
    A. I only
    B. II only
    C. III only
    D. I and II
    E. I, II, and III

25. Which of the following is the solubility-product constant expression for the equilibrium dissociation of ferric peroxide?
    A. $K_{sp}$ = [$Fe^{3+}$]$^2$[$O_2^{2-}$]$^3$
    B. $K_{sp}$ = [2 $Fe^{3+}$]$^2$[3 $O_2^{2-}$]$^3$
    C. $K_{sp}$ = (2[$Fe^{3+}$]$^2$) (3[$O_2^{2-}$]$^3$)
    D. $K_{sp}$ = [$Fe^{2+}$][$O_2^{2-}$]
    E. $K_{sp}$ = 1 / ([$Fe^{2+}$][$O_2^{2-}$])

26. Which of the following chemical reactions has the greatest increase in entropy?
    A. 2 $H_2$ (g) + $O_2$ (g) → 2 $H_2O$ (g)
    B. 2 $H_2O$ (g) → 2 $H_2$ (g) + $O_2$ (g)
    C. 2 $H_2$ (g) + $O_2$ (g) → 2 $H_2O$ (l)
    D. 2 $H_2O$ (l) → 2 $H_2$ (g) + $O_2$ (g)
    E. Not enough information is provided.

27. For which of the following is the standard Gibbs free energy of formation and the standard molar entropy equal to zero?

    I. $H_2O$ (l)
    II. $H_2$ (g)
    III. Ne (g)

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

28. In the following chemical equation which takes place in acidic solution, how many moles of water are represented?

    $Cr^{3+}$ (aq) → $CrO_4^{2-}$ (aq) + Cr (s)

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

29. Which of the following elements is the best oxidizing agent?

    A. $H_2$
    B. Li
    C. $O_2$
    D. Cu
    E. Not enough information.

30. In the electrolysis of water, what is produced at the cathode?

    A. Electrons
    B. Hydrogen
    C. Hydronium
    D. Hydroxide
    E. Oxygen

31. A neutron fuses with a uranium-238 nucleus. The product of this nuclear reaction then undergoes positron decay. The product of this decay is:

    A. Neptunium-238
    B. Neptunium-239
    C. Protactinium-238
    D. Protactinium-239
    E. Uranium-239

32. How much of a 150.0 mg sample of a radionuclide remains after three half-lives?

    A. 10.00 mg
    B. 18.75 mg
    C. 37.50 mg
    D. 50.00 mg
    E. 120.00 mg

33. 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. $N_2O_7$

34. Which of the following is diamagnetic?
    A. Cu
    B. $Mn^{2+}$
    C. $O_2$
    D. $Sc^{2+}$
    E. $Zn^{2+}$

35. The complex in $[CuBr(NH_3)_3]_3PO_3$:
    I. Is called triamminebromocopper (I) phosphite
    II. Is called triamminebromocopper (II) phosphite
    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

36. Which of the following compounds is an alkyne?
    A. $C_3H_8$
    B. $C_3H_6$
    C. $C_6H_6$
    D. $C_{17}H_{32}$
    E. $C_2H_8$