一、單選題：每題四分

1. What volume of 18.0 M sulfuric acid must be used to prepar 15.5 L of 0.195 M H_2SO_4?

    a) 168 mL   b) 0.336 L   c) 92.3 mL   d) 226 mL

2. Consider a solution consisting of the following two buffer systems:

    $H_2CO_3 = HCO_3^- + H^+$ $pK_a = 6.4$

    $H_2PO_4^- = HPO_4^{2-} + H^+$ $pK_a = 7.2$

At pH 6.4, which one of the following is true of the relative amounts of acid and conjugate base present?

    a) $[H_2CO_3] > [HCO_3^-]$ and $[H_2PO_4^-] > [HPO_4^{2-}]$

    b) $[H_2CO_3] = [HCO_3^-]$ and $[H_2PO_4^-] > [HPO_4^{2-}]$

    c) $[H_2CO_3] = [HCO_3^-]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$

    d) $[HCO_3^-] > [H_2CO_3]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$

    e) $[H_2CO_3] > [HCO_3^-]$ and $[HPO_4^{2-}] > [H_2PO_4^-]$

3. For ammonia, K_b is 1.8×10^{-5}. To make a buffered solution with pH 10.0, the ratio of NH_4Cl to NH_3 must be

    a) 1.8 : 1   b) 1:1.8   c) 0.18 : 1   d) 1 : 0.18

4. You have two salts, AgX and AgY, with very similar K_{sp} values.   You know that K_a for HX is much greater than K_a for HY.   Which salt is more soluble in acidic solution?

    a) AgX   b) AgY   c) they are equally soluble in acidic solution   d) Cannot be determined by the information given

5. Calculate ΔH° for the reaction $C_4H_{4(g)} + 2 H_{2(g)} \rightarrow C_4H_{8(g)}$, using the following data: $\Delta H^\circ_{combustion}$ for $C_4H_{4(g)} = -2341$ kJ/mol

      $\Delta H^\circ_{combustion}$ for $H_{2(g)} = -286$ kJ/mol

      $\Delta H^\circ_{combustion}$ for $C_4H_{8(g)} = -2755$ kJ/mol

    a) −128 kJ   b) −158 kJ   c) 128 kJ   d) 158 kJ

6. For the reaction $CO_{(g)} + 2H_{2(g)} = CH_3OH_{(g)}$, $\Delta G^\circ_{700K} = -13.46$ kJ. The K_p for this reaction at 700 K is:

    a) 10.1   b) 16.7   c) 22.5   d) 9.9×10^{-2}

7. The reduction potentials for Au^{3+} and Ni^{2+} are as follows:

    $Au^{3+} + 3e^- \rightarrow Au$ $E^\circ = +1.50V$

    $Ni^{2+} + 2e^- \rightarrow Ni$ $E^\circ = -0.23$ V

Calculate ΔG° (at 25°C) for the reaction: $2Au^{3+} + 3Ni \rightarrow 3 Ni^{2+} + 2Au$

    a) -5.00×10^2 kJ   b) $+5.00 \times 10^2$ kJ   c) −2140 kJ   d) -1.00×10^3 kJ

（背面仍有題目，請繼續作答）

8. A fuel cell designed to react grain alcohol with oxygen has the following net
   reaction:　$C_2H_5OH_{(l)} + 3\ O_{2(g)} \rightarrow 2CO_{2(g)} + 3\ H_2O_{(l)}$
   The maximum work one mole of alcohol can yield by this process is 1320 kJ.
   What is the theoretical maximum voltage this cell can achieve?
   a) 0.760 V　b) 1.14 V　c) 2.01 V　d) 2.28 V

9. How many electrons can be described by the quantum numbers $n = 4$, $l = 3$, $m_l = 1$,
   $m_s = 1$?
   a) 0　　b) 1　　c) 2　　d) 6　　e) 10

10. The electron configuration of Cr^{3+} is
    a) $[Ar]4s^23d^1$　b) $[Ar]4s^13d^2$　c) $[Ar]3d^3$　d) $[Ar]4s^23d^4$

11. Which of the following molecules does not have a dipole moment?
    a) H_2S　b) H_2O　c) H_2Xe　d) CH_3OH

12. Which of the following ionic compounds has the largest lattice energy?
    a) CsI　b) MgO　c) LiF　d LiI

13. How many Lewis structures does CO_3^{2-} have?
    a) 1　b) 2　c) 3　d) 4

14. What is the hybridization of the I atom in the molecule IF_4^- ?
    a) sp　b) sp^2　c) sp^3　d) dsp^3　e) d^2sp^3

15. A first-order reaction is 35% complete at the end of 55 minutes.　What is the
    value of the rate constant?
    a) 1.9×10^{-3} min^{-1}　b) 3.8×10^{-3} min^{-1}　c) 7.8×10^{-3} min^{-1}　d) 36 min^{-1}

16. The rate constant for a reaction increases from 10.0 s^{-1} to 100 s^{-1} when the
    temperature is increased from 300 K to 400 K. What is the activation energy for
    the reaction in kJ/mol? (R = 8.314 J/mol K)
    a) 23.0　b) 12.7　c) 5.00　d) 18.3

17. Sodium oxide (Na_2O) crystallizes in a structure in which the O^{2-} ions are in a
    face-centered cubic lattice and the Na^- ions are in tetrahedral holes.　The
    number of Na^+ ions in the unit cell is:
    a) 2　b) 4　c) 6　d) 8

18 Chromium metal crystallizes as a body-centered cubic lattice.　If the atomic
   radius of Cr is 1.25 angstroms, what is the density of Cr metal in g/cm^3?
   a) 2.76　b) 3.52　c) 5.52　d) 7.18

19. Which of the following coordination compound will form a precipitate when treated with an aqueous solution of $AgNO_3$?

　　a) $[Cr(NH_3)_3Cl_3]$　　b) $[Cr(NH_3)_6]Cl_3$　　c) $[Cr(NH_3)Cl]SO_4$

　　d) $Na[Cr(CN)_6]$　　e) $Na_3[CrCl_6]$

20. Which of the following is paramagnetic?

　　a) $Zn(H_2O)_6^{2+}$　　b) $Co(NH_3)_6^{3+}$ (strong field)　　c) $Cu(CN)_3^{2-}$

　　d) $Mn(CN)_6^{2-}$ (strong field)

21. Which of the following is true in describing the crystal field model?

　　a) The metal ion and ligand interaction is treated as a Lewis acid-base interaction

　　b) The ligands are treated as negative point charges.

　　c) The metal ion-ligand bonds are considered to be completely ionic.]

　　d) The electrons are assumed to be localized.

22. How many isomers are there with the formula $C_2H_2Br_2$?　　Include both structural and geometric isomers.

　　a) 2　　b) 3　　c) 4　　d) 5　　e) 6

23. Which of the following is optically active (i.e. chiral)?

　　a) $HN(CH_3)_2$　　b) CH_2Cl_2　　c) 2-chloropropane　　d) 2-chlorobutane

　　e) 3-chloropentane

二、簡答題：每題四分

1. What are the products of the reaction, which is the major product?
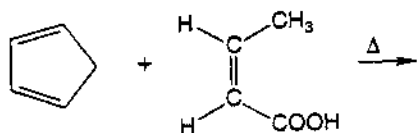
2. What is the main product of each of the reactions?