L.S.F.

CHM 201

FINAL

L.S.F. ALWAYS READY TO HELP!!

Multiple choice

1. If solid ammonium fluoride (NH_4F) is dissolved in pure water, will the solution formed be acidic, basic or neutral?

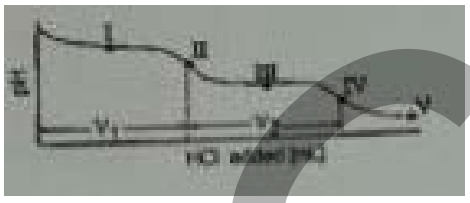
For NH_3, $K_b = 1.8x\ 10^{-3}$; for HF, $K_a = 7.2 \times 10^{-4}$

   a) Acidic
   b) Basic
   c) Neutral
   d) Cannot be determined without additional information

2. Consider the below graph about the diprotic ascorbic acid (H_2As for short).

	K_{a1}	pK_a
$H_2As \rightleftharpoons H^+ + HAs^-$	7.9×10^{-5}	4.10
$HAs^- \rightleftharpoons H^+ + As^{2-}$	1.6×10^{-12}	11.79

The titration curve for disodium acerbate, Na_2As with standard HCl is shown below:



What major species is(are) present at point III?

   a) As^{2-} and HAs^-
   b) HAs^- only
   c) HAs^- and H_2As
   d) H_2As only
   e) H_2As and H+

3. Consider a solution of 2.0 M HCN and 1.0 M NaCN (K_a for HCN = 6.2×10^{-10}). Which of the following statements is true?
   a) The solution is not a buffer because [HCN] is not equal to [CN-]
   b) The pH will be below 7.00 because the concentration of the acid is greater than that of the base.
   c) [OH-] > [H+]
   d) The buffer will be more resistant to pH changes from addition of strong acid than to pH changes from addition of strong base.
   e) All of these statements are false.

4. Which of the following solutions will be the best buffer at a pH of 9.267? (K_a for $HC_2H_3O_2$ is 1.8×10^{-3}; K_b for NH_3 is 1.8×10^{-5})
   a. 0.20 M $HC_2H_3O_2$ and 0.20 M $NaC_2H_3O_2$

b. 3.0 M $HC_2H_3O_2$ and 3.0 M NH_4Cl
c. 0.20 M NH_3 and 0.20 M NH_4Cl
d. 3.0 M NH_2 and 3.0 M NH_4Cl
e. 3.0 M $HC_2H_3O_2$ and 3.0 M NH_3

5. What mass of K_2CO_3 is needed to prepare 200 mL of a solution having a potassium ion concentration of 0.150 M?
   a. 4.15 g
   b. 10.4 g
   c. 13.8 g
   d. 2.07 g
   e. 1.49 g

6. The concentration of oxalate ion ($C_2O_4^{2-}$) in a sample can be determined by titration with a solution of permanganate ion (MnO_4^-) of known concentration. The net ionic equation for this reaction is:
   $2MnO_4^- + 5C_2O_4^{2-} + 16H+ \rightarrow 2Mn^{2+} + 8\ H_2O + 10CO_2$
   A 30.00 mL sample of an oxalate solution is found to react completely with 21.93 mL of a 0.1725 M solution of MnO_4^-. What is the oxalate ion concentration in the sample?

   a. 0.02914 M
   b. 0.4312 M
   c. 0.1821 M
   d. 0.3152 M
   e. 0.005044 M

7. A 707 mg sample of a gas containing only carbon and oxygen occupies a volume of 452 mL at 63°C and 745 mm Hg. Identify the gas in the sample.
   a. CO
   b. CO2
   c. CO_3^{2-}
   d. C_2O

8. 1.000 atm of oxygen gas, placed in a container having a pinhole opening in its side, leaks from the container 2.14 times faster than does 1.000 atm of an unknown gas placed in this same apparatus. Which of these species could be the unknown gas?
   a. Cl_2
   b. SF_6
   c. Kr
   d. UF_6
   e. Xe

9. Three 1.00-L flasks at 25°C and 725 torr contain the gases CH_4 (flask A), CO_2 (flask B), and C_2H_6 (flask C). In which single flask do the molecules have the highest kinetic energy?
   a. Flask A b. flask B c. flask C d. all e. none

10. Calculate the frequency of the light emitted by a hydrogen atom during a transition of its electron from the n = 4 to the n = 1 principal energy level.
   a. 1.35×10^{-51} /s
   b. 1.03×10^{8} /s
   c. 2.06×10^{34} /s
   d. 8.22×10^{14} /s
   e. 3.08×10^{15} /s

11. Identify the correct net ionic equation for the reaction that occurs when solution of Na_3PO_4 and $Ca(NO_3)_2$ are mixed
   a) $Ca^{2+} + PO_4^{2-}{}_{(aq)} \rightarrow CaPO_{4(S)}$
   b) $3Ca^{2+}{}_{(aq)} + 2PO_4^{2-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(S)}$
   c) $Na^{+}{}_{(aq)} + NO_3^{-}{}_{(aq)} \rightarrow NaNO_{3(S)}$
   d) $Na^{+}{}_{(aq)} + Ca^{2+}{}_{(aq)} + PO_4^{2-}{}_{(aq)} \rightarrow NaCaPO_{4(s)}$

12. In the following chemical reaction the oxiding agent is

$5H_2O_2 + 2MnO_4^{-} + 6H^{+} \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

   a) H_2O_2
   b) MnO_4^{-}
   c) H^{+}
   d) Mn^{2+}
   e) O_2

13. Which of the following exihibits the correct orders (increasing) for atomic radius and ionization energy respectively?
   a) S,O,F and F,O,S
   b) F,S,O and O,S,F
   c) S,F,O and S,F,O
   d) F,O,S and S,O,F
   e) None of the above

14. Give the number of lone pairs around the central atom and the geometry of the ion IBr_2^{-}
   a) 0 lone pairs, linear
   b) 3 lone pairs bent
   c) 1 lone pair, bent
   d) 3 lone pairs linear
   e) 2 lone pairs, bent

15. The number of resonance structure for the sulfur dioxide molecule that satisfy the octet rule is
    a) 1
    b) 2
    c) 3
    d) 4

16. The value of the equilibrium constant K depends on

I the initial concentration of the reactants

II the initial concentration of the products

III the final concentration of the reactants

IV the final concentration of the products

    a) I and II
    b) II and II
    c) II and IV
    d) Three of the above
    e) None of the above

17. A sample is composed of the elements Potassium, nitrogen and oxygen. What is the empirical formula if it is 38.7 % potassium and 13.9 % nitrogen?
    a) $K_2N_2O_3$
    b) KNO_2
    c) KNO_3
    d) KN_2O_3

18. How much Al_2O_3 is formed from the reaction of 120 g of Al and 120 g of oxygen if the percent yield is 91.6 %? The unbalanced equation is: $Al + O_2 \rightarrow Al_2O_3$.
    a) 193 g
    b) 207 g
    c) 226 g
    d) None of the above

19. Predict any solid products which would form if solutions of ammonium carbonate, sodium phosphate and barium chloride are mixed.
    a) Ammonium phosphate
    b) Barium carbonate
    c) Barium carbonate and barium phosphate
    d) No reaction would occur

20. How many grams of gas will be formed if 0.243 g of Mg is dissolved completely in the HCl solution? (Hint: write balanced reaction first)
    a) 0.02 g
    b) 0.03 g
    c) 0.05 g
    d) 0.08g

21. If 36.2 g of $CaS_{2\ (s)}$ were allowed to completely react with $H_2O_{\ (l)}$ giving calcium hydroxide and hydrogen gas at 1.3 atm and 18.7°C, what would be the resulting $H_{2\ (g)}$ volume?
    a) 31.7 L
    b) 41.2 L
    c) 53.6 L
    d) None of the above

22. Ammonia and nitric acid vapors enter a 1.00 millimeter evacuated linear tube from opposite ends. They effuse through the tube until they meet each other and form ammonium nitrate. How many millimeters does the ammonium nitrate form from the end which the nitric acid entered?
    a) 1.9 mm
    b) 0.526 mm
    c) 0.657 mm
    d) 0.342 mm

23. $N_{2(g)} + 3\ H_{2(g)} \rightarrow 2\ NH_{3(g)}$ $\Delta H = -91.8$ kJ . What is ΔH if 45.0g N_2 reacted with 13.0g H_2?
    a) -147 kJ
    b) -1184 kJ
    c) -394.74 kJ

24. A student mixes 100 mL of 0.50 M NaOH with 100 mL of 0.50 M HCl in a Styrofoam cup and observes a temperature increase of $\Delta T1$. When she repeats this experiment using 200 mL of each solution, she observed a temperature change of $\Delta T2$. If no heat is lost to the surroundings or absorbed by the cup, what is true about $\Delta T1$ and $\Delta T2$?
    a) $\Delta T2 = \Delta T1$
    b) $\Delta T2 = 0.5\ \Delta T1$
    c) $\Delta T2 = 2\ \Delta T1$
    d) $\Delta T2 = 4\ \Delta T1$

25. Water gas, a commercial fuel, is made by the reaction of hot coke carbon with steam
    $C_{(s)} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)}$
    When equilibrium is established at 800°C, the concentrations of CO, H_2 and H_2O are $4.00*10^{-2}$ mol/L, $4.00*10^{-2}$ mol/L and $1.00*10^{-2}$ mol/L respectively. Calculate the value of $\Delta G°$ for this reaction at 800°C.
    a) 109 kJ

b) -43.5 kJ
c) 193 kJ
d) 16.3 kJ
e) None of the above

26. At constant pressure, this reaction $2NO_{2\ (g)} \rightleftharpoons N_2O_{4\ (g)}$ is exothermic. The reaction (as written) is:
    a) Always spontaneous
    b) Spontaneous at low temperatures but not at high
    c) Spontaneous at high temperatures but not at low
    d) Never spontaneous

27. How many electrons can be described by the quantum numbers n=3, l=1 and m=1/2.
    a) 1
    b) 2
    c) 3
    d) 5
    e) 6

28. Which of the following molecules has a dipole moment?
    a) BCl_3
    b) $SiCl_4$
    c) PCl_3
    d) Cl_2
    e) None of the above

29. What is the orbital geometry of SO_3^{2-} ?
    a) Linear
    b) Trigonal planar
    c) Tetrahedral
    d) Octahedral'

30. In which of the following compounds does the bond between the central atom and fluorine have the greatest ionic character?
    a) OF_2
    b) SF_2
    c) SeF_2
    d) AsF_3
    e) SbF_3

31. What is the molality of a solution of 31.8 g of ethanol (CH_3CH_2OH) in 481 mL of water if the density of water is 1.0 g/mL?
    a) 1.35 m
    b) 0.0258 m
    c) 1.44 m
    d) 0.0252 m
    e) 66.1 m

32. What is the mole percent of ethanol (CH_3CH_2OH) in the vodka, which consists of 71.0 g of ethanol for every 10.0g of water present?
    a) 73.5 %
    b) 71.0 %
    c) 87.7 %
    d) 26.5 %
    e) 22.1 %

33. Rank the following compounds according to their solubilities in water:
    I. CH3 – CH2 –CH2 – CH3
    II. HO – CH2 – CH2 – OH
    III. CH3 – CH2 – OH
    IV. CH3 – CH3
        a) I < III < IV < II
        b) I < VI < II < III
        c) III < VI < II < I
        d) I < VI < III < II

34. Calculate the osmotic pressure in torr of 5.82 L of an aqueous 0.148 M solution of Na_2SO_4 at 25°C,
    a) 2.34×10^4 torr
    b) 8.26×10^3 torr
    c) 2.75×10^3 torr
    d) 3.04×10^{-2} torr
    e) 6.93×10^2 torr

35. To calculate the freezing point of an ideal dilute solution of a single, nondissociating solute in a solvent, the minimum information one must know is:
    I. The molality (of solute)
    II. The molality (of solute) and the freezing-point-depression constant of the solvent
    III. The freezing point of the pure solvent
    IV. The molecular weight of the solute
        a) I only
        b) II only

c) II, III only
d) II, III, VI

36. At a particular temperature, the ion product constant of water is K_w = 2.4 x 10-14. What is the pH of pure water at this temperature?
    a) 7.00
    b) 7.19
    c) 6.56
    d) 6.81
    e) 6.62

37. Calculate $[H^+]$ in a buffer solution that is 0.34 M in NaF and 0.58 M in HF. K_a (HF) = 7.2×10^{-4}
    a) 0.58 M
    b) 4.2×10^{-4} M
    c) 1.2×10^{-3} M
    d) 2.0×10^{-2} M
    e) 1.1×10^{-4} M

38. 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

39. How much water should be added to 10.0 mL of 12.0 M HCl so that it has the same pH as 0.90 M acetic acid ($K_a = 1.8 \times 10^{-5}$) ? (Assume volumes are additive)
    a) 30 mL
    b) 300 mL
    c) 3 L
    d) 30 L
    e) 300 L

40. For the reaction $CO_{2\,(g)} + 2\,H_2O_{\,(g)} \rightarrow CH_{4\,(g)} + 2O_{2\,(g)}$ $\Delta H° = 803$ kJ
    Which of the following will increase K?
    a) Decreasing the number of moles of methane
    b) Increasing the volume of the system
    c) Increasing the temperature of the system
    d) All of these
    e) None of these

Please show complete work for full grade:

I. Calculate the pH after adding 20.00 mL of 2 M NaOH to 1.00 liter of the buffer solution containing 0.58 M HF/ 0.34 M NaF ($K_a = 7.2x10^{-4}$)

pH= 2.987

II. When a 19.8 g sample of an un-dissociated unknown compound is dissolved in 522 g of benzene, the freezing point of the resulting solution is 3.86°. The freezing point of pure benzene is 5.48°, and K_f for benzene is 5.12 °C/m. Calculate the molar mass of the unknown compound.

1.20×10^2 g/mol

III. What is the pH of a 0.200 M NH_4F, given K_b (NH_3) = 1.8×10^{-5} and K_a (HF) = 7.2×10^{-4}?