1042_2nd Exam_1050518(A)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Identify a good buffer.
   A) significant amounts of both a weak acid and its conjugate base
   B) small amounts of both a strong acid and a strong base
   C) significant amounts of both a weak acid and a strong acid
   D) significant amounts of both a strong acid and a strong base
   E) small amounts of both a weak acid and its conjugate base

   Answer: A

2) If the pKa of $HCHO_2$ is 3.74 and the pH of an $HCHO_2/NaCHO_2$ solution is 3.11, which of the following is TRUE?
   A) $[HCHO_2] > [NaCHO_2]$
   B) $[HCHO_2] < [NaCHO_2]$
   C) $[HCHO_2] << [NaCHO_2]$
   D) $[HCHO_2] = [NaCHO_2]$
   E) It is not possible to make a buffer of this pH from $HCHO_2$ and $NaCHO_2$.

   Answer: A

3) Calculate the pH of a buffer that is 0.225 M $HC_2H_3O_2$ and 0.162 M $KC_2H_3O_2$. The K_a for $HC_2H_3O_2$ is 1.8×10^{-5}.
   A) 9.26 B) 4.74 C) 9.11 D) 4.89 E) 4.60

   Answer: E

4) Calculate the pH of a solution formed by mixing 250.0 mL of 0.15 M NH_4Cl with 200.0 mL of 0.12 M NH_3. The K_b for NH_3 is 1.8×10^{-5}.
   A) 9.45 B) 9.26 C) 4.74 D) 9.06 E) 4.55

   Answer: D

5) Which of the following is TRUE?
   A) An effective buffer has a [base]/[acid] ratio in the range of 10 - 100.
   B) A buffer is most resistant to pH change when [acid] = [conjugate base]
   C) A buffer can not be destroyed by adding too much strong base. It can only be destroyed by adding too much strong acid.
   D) An effective buffer has very small absolute concentrations of acid and conjugate base.
   E) None of the above are true.

   Answer: B

6) When titrating a strong monoprotic acid and KOH at 25°C, the
   A) pH will be equal to 7 at the equivalence point.
   B) pH will be greater than 7 at the equivalence point.
   C) titration will require more moles of acid than base to reach the equivalence point.
   D) pH will be less than 7 at the equivalence point.
   E) titration will require more moles of base than acid to reach the equivalence point.

   Answer: A

7) A 100.0 mL sample of 0.10 M NH_3 is titrated with 0.10 M HNO_3. Determine the pH of the solution after the addition of 150.0 mL of HNO_3. The K_b of NH_3 is 1.8×10^{-5}.

A) 6.44 B) 2.30 C) 7.56 D) 12.30 E) 1.70

Answer: E

8) A 100.0 mL sample of 0.20 M HF is titrated with 0.10 M KOH. Determine the pH of the solution after the addition of 300.0 mL of KOH. The K_a of HF is 3.5×10^{-4}.

A) 9.33 B) 5.06 C) 12.40 D) 12.00 E) 8.94

Answer: C

9) Determine the molar solubility of AgBr in a solution containing 0.150 M NaBr. K_{sp} (AgBr) = 7.7×10^{-13}.

A) 3.9×10^{-13} M
B) 0.150 M
C) 5.8×10^{-5} M
D) 8.8×10^{-7} M
E) 5.1×10^{-12} M

Answer: E

10) Give the equation for an unsaturated solution in comparing Q with K_{sp}.

A) $Q > K_{sp}$
B) $Q < K_{sp}$
C) $Q \neq K_{sp}$
D) $Q = K_{sp}$
E) none of the above

Answer: B

11) A solution containing $AgNO_3$ is mixed with a solution of NaCl to form a solution that is 0.10 M in $AgNO_3$ and 0.075 M in NaCl. What will happen once these solutions are mixed? K_{sp} (AgCl) = 1.77×10^{-10}.

A) Silver chloride will precipitate out of solution, leaving a saturated AgCl solution.
B) Nothing will happen since NaCl and $AgNO_3$ are both soluble compounds.
C) Silver chloride will precipitate out of solution, leaving an unsaturated solution of AgCl.
D) Nothing will happen since the molar solubility of AgCl is higher than the solution concentrations.
E) There is not enough information to say anything about this solution.

Answer: A

12) A solution contains 0.021 M Cl^- and 0.017 M I^-. A solution containing copper (I) ions is added to selectively precipitate one of the ions. At what concentration of copper (I) ion will a precipitate begin to form? What is the identity of the precipitate? K_{sp}(CuCl) = 1.0×10^{-6}, K_{sp}(CuI) = 5.1×10^{-12}.

A) 3.0×10^{-10} M, CuCl
B) 3.0×10^{-10} M, CuI
C) 4.8×10^{-5} M, CuCl
D) 4.8×10^{-5} M, CuI
E) No precipitate will form at any concentration of copper (I).

Answer: B

13) A solution contains 2.2×10^{-3} M in Cu^{2+} and 0.33 M in LiCN. If the K_f for $Cu(CN)_4^{2-}$ is 1.0×10^{25}, how much copper ion remains at equilibrium?

A) 1.9×10^{-26} M
B) 3.8×10^{-24} M
C) 6.7×10^{-28} M
D) 4.6×10^{-25} M
E) 2.9×10^{-27} M

Answer: A

14) Which of the following statements is TRUE?

A) Perpetual motion machines are a possibility in the near future.
B) The entropy of a system always decreases for a spontaneous process.
C) A spontaneous reaction is always a fast reaction.
D) There is a "heat tax" for every energy transaction.
E) None of the above are true.

Answer: D

15) The _____ Law of Thermodynamics states the energy is conserved in chemical processes.

A) Zero B) First C) Second D) Third E) Fourth

Answer: B

16) _____ is a thermodynamic function that increases with the number of energetically equivalent ways to arrange components of a system to achieve a particular state.

A) Entropy
B) Free energy
C) Molar equivalence
D) Enthalpy
E) Heat of reaction

Answer: A

17) The _____ Law of Thermodynamics states that for any spontaneous reaction, the entropy of the universe increases.

A) Zero B) First C) Second D) Third E) Fourth

Answer: C

18) Which of the following processes have a $\Delta S > 0$?

A) $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$
B) $Na_2CO_3(s) + H_2O(g) + CO_2(g) \rightarrow 2\ NaHCO_3(s)$
C) $CH_3OH(l) \rightarrow CH_3OH(s)$
D) $CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\ H_2(g)$
E) All of the above processes have a $\Delta S > 0$.

Answer: D

19) Which of the following statements is TRUE?

A) Endothermic processes decrease the entropy of the surroundings, at constant T and P.
B) Endothermic processes are never spontaneous.
C) Exothermic processes are always spontaneous.
D) Entropy is not a state function.
E) None of the above are true.

Answer: A

20) Which of the following relationships is correct at constant T and P?

A) $\Delta G > 0$ represents an increase in kinetic energy
B) $\Delta G < 0$ represents a nonspontaneous process
C) ΔG is proportional to $-\Delta S_{univ}$
D) $\Delta G > 0$ represents a spontaneous process
E) All of the above are correct

Answer: C

21) Consider a reaction that has a positive ΔH and a positive ΔS. Which of the following statements is TRUE?

A) This reaction will be nonspontaneous at all temperatures.
B) This reaction will be spontaneous at all temperatures.
C) This reaction will be nonspontaneous only at high temperatures.
D) This reaction will be spontaneous only at high temperatures.
E) It is not possible to determine without more information.

Answer: D

22) For the following example, identify the following.

$$2\ N_2O(g) \rightarrow 2\ N_2(g) + O_2(g)$$

A) a negative ΔH and a negative ΔS
B) a negative ΔH and a positive ΔS
C) a positive ΔH and a positive ΔS
D) a positive ΔH and a negative ΔS
E) It is not possible to determine without more information.

Answer: B

23) Above what temperature does the following reaction become nonspontaneous?

$$2\ H_2S(g) + 3\ O_2(g) \rightarrow 2\ SO_2(g) + 2\ H_2O(g) \qquad \Delta H = -1036\ kJ;\ \Delta S = -153.2\ J/K$$

A) 298 K
B) 158.7 K
C) 6.762×10^3 K
D) This reaction is nonspontaneous at all temperatures.
E) This reaction is spontaneous at all temperatures.

Answer: C

24) The _____ Law of Thermodynamics states the entropy of a perfect crystal at absolute zero is zero.

A) Zero B) First C) Second D) Third E) Fourth

Answer: D

25) Which of the following statements is TRUE?

A) $\Delta S_{universe}$ is always greater than zero for a nonspontaneous process.
B) Entropy is not temperature dependent.
C) Exothermic processes decrease the entropy of the surroundings.
D) Entropy is an extensive property.
E) None of the above are true.

Answer: D

26) Place the following in order of decreasing standard molar entropy.

$N_2O_4(g)$ $NO(g)$ $NO_2(g)$

A) $NO > NO_2 > N_2O_4$
B) $NO_2 > NO > N_2O_4$
C) $N_2O_4 > NO_2 > NO$
D) $NO > N_2O_4 > NO_2$
E) $N_2O_4 > NO > NO_2$

Answer: C

27) Calculate the $\Delta G°_{rxn}$ using the following information.

$2\ HNO_3(aq) + NO(g) \rightarrow 3\ NO_2(g) + H_2O(l)$ $\Delta G°_{rxn}$ = ? (at room temperature)

$\Delta H°_f$ (kJ/mol)	-207.0	91.3	33.2	-285.8
S°(J/mol·K	146.0	210.8	240.1	70.0

A) -85.5 kJ B) +50.8 kJ C) -151 kJ D) -186 kJ E) +222 kJ

Answer: B

28) Use Hess's law to calculate $\Delta G°_{rxn}$ using the following information.

$NO(g) + O(g) \rightarrow NO_2(g)$ $\Delta G°_{rxn}$ = ?

$2\ O_3(g) \rightarrow 3\ O_2(g)$ $\Delta G°_{rxn}$ = +489.6 kJ
$O_2(g) \rightarrow 2\ O(g)$ $\Delta G°_{rxn}$ = +463.4 kJ
$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$ $\Delta G°_{rxn}$ = - 199.5 kJ

A) -1152.5 kJ B) +753.5 kJ C) -225.7 kJ D) +277.0 kJ E) -676.0 kJ

Answer: E

29) Choose the statement below that is TRUE.

A) $K < 1$, $\Delta G°_{rxn}$ is negative.
B) $\Delta G°_{rxn} = 0$ at equilibrium.
C) $K > 1$, $\Delta G°_{rxn}$ is positive.
D) $\Delta G_{rxn} = 0$ at equilibrium.
E) None of the above statements are true.

Answer: D

30) Determine the equilibrium constant for the following reaction at 655 K.

$HCN(g) + 2\ H_2(g) \rightarrow CH_3NH_2(g)$ $\Delta H° = -158$ kJ; $\Delta S° = -219.9$ J/K

A) 13.0 B) 3.26×10^{-12} C) 3.99×10^{12} D) 3.07×10^{11} E) 2.51×10^{-13}

Answer: A

31) Identify the ion that is responsible for the red color of rubies.

A) Cr^{5+} B) Cr^{7+} C) Cr^{3+} D) Cr^{6+} E) Cr^{4+}

Answer: C

32) Choose the electron configuration for Fe^{3+}.

A) $[Ar]3d^5$ B) $[Ar]4s^23d^9$ C) $[Ar]4s^23d^6$ D) $[Ar]4s^13d^4$ E) $[Ar]4s^23d^3$

Answer: A

33) Name the following: $[Fe(H_2O)_4Br_2]Cl$

A) tetraaquadibromoiron(II) chloride
B) iron(II)dibromotetraquachloride
C) dibromotetrahydroiron(II)chloride
D) dibromotetrahydroironchloride
E) tetraaquadibromoiron(III) chloride

Answer: E

34) Identify the isomers that have ligands with different spatial arrangements about the metal ions.

A) coordination isomers
B) structural isomers
C) linkage isomers
D) geometric isomers
E) constitutional isomers

Answer: D

35) Which of the following pairs of coordination compounds or complex ions are examples of coordination isomers?

A) $[Fe(CO)_5NO_2]^{2+}$ and $[Fe(CO)_5ONO]^{2+}$
B) $[Fe(NH_3)_2(H_2O)_4]Cl_2$ and $[Fe(NH_3)_4(H_2O)_2]Cl_2$
C) $[MnCl_3Br]^{2-}$ and $[MnClBr_3]^{2-}$
D) $[Fe(NH_3)_2(H_2O)_4]Cl_2$ and $[Fe(NH_3)_2(H_2O)_4]Br_2$
E) $[Cu(CO)_5Br]Cl$ and $[Cu(CO)_5Cl]Br$

Answer: E

36) Which of the following compounds can exhibit cis-trans isomerism?

A) $[Cr(H_2O)_6]^{3+}$
B) $[MnClBr_3]^{2-}$
C) $[Fe(CO)_5NO_2]^{2+}$
D) $[Cu(CO)_5Cl]^{+}$
E) $[Ni(CO)_2(NH_3)_2]^{2+}$

Answer: E

37) Which of the following complex ions absorbs light of the shortest wavelength?

A) $[FeCl_6]^{3-}$

B) $[Fe(OH)_6]^{3-}$

C) $[Fe(CN)_6]^{3-}$

D) $[Fe(H_2O)_6]^{3+}$

E) $[FeI_6]^{3-}$

Answer: C

38) The complex ion, $[Ni(NH_3)_6]^{2+}$, has a maximum absorption near 580 nm. Calculate the crystal field splitting energy (in kJ/mol) for this ion.

A) 343 kJ/mol B) 206 kJ/mol C) 485 kJ/mol D) 114 kJ/mol E) 292 kJ/mol

Answer: B

39) How many unpaired electrons would you expect for the complex ion: $[Co(OH)_6]^{3-}$?

A) 0 B) 4 C) 2 D) 1 E) 3

Answer: B

40) Identify the shape of the hemoglobin complex.

A) heptadral B) octahedral C) hexadral D) pentadral E) tetrahedral

Answer: B