***General Chemistry*, 10e Cdn (Petrucci)**
Chapter 17 Additional Aspects of Acid-Base Equilibria

1) The common ion in a mixture of a weak acid and a strong acid is the hydronium ion.
Answer: TRUE
Diff: 2 Type: TF
Reference: Section 17-1

2) The pH of a buffer solution changes only slightly with addition of a small amount of acid or base.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 17-2

3) The pH of a buffer depends mainly on the pK_a of the weak acid component of the buffer.
Answer: TRUE
Diff: 2 Type: TF
Reference: Section 17.2

4) For an accurate titration, the end point needs to match the equivalence point.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 17-4

5) A weak acid-strong base will produce a longer vertical section of a titration curve than will a strong acid-strong base.
Answer: FALSE
Diff: 1 Type: TF
Reference: Section 17-4

6) A solution of sodium carbonate is easier to calculate the pH than sodium hydrogen carbonate because there is only one hydrolysis reaction instead of two.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 17-5

7) How will addition of sodium acetate to an acetic acid solution affect the pH?
A) It will lower the pH.
B) The pH will not change.
C) The solution becomes hotter.
D) The pH cannot be measured.
E) It will raise the pH.
Answer: E
Diff: 1 Type: MC
Reference: Section 17-1

8) What is the $[H_3O^+]$ of a solution measured to be 0.20 M in sodium acetate and 0.40 M in acetic acid? $[K_a = 1.8 \times 10^{-5}]$
A) 1.8×10^{-5} M

B) 9.0×10^{-6} M
C) 3.6×10^{-5} M
D) 7.2×10^{-5} M
E) 4.7 M
Answer: C
Diff: 1 Type: MC
Reference: Section 17-1

9) What is the concentration of the acetate ion of a solution measured to be 0.20 M acetic acid and 0.20 M in hydrochloric acid? [K_a for acetic acid = 1.8×10^{-5}]
A) 3.6×10^{-5} M
B) 9.0×10^{-6} M
C) 1.8×10^{-5} M
D) 7.2×10^{-5} M
E) 0.20 M
Answer: C
Diff: 1 Type: MC
Reference: Section 17-1

10) Ten milliliters of 0.10 M $NH_3(aq)$ ($K = 1.8 \times 10^{-5}$) is mixed with 10 mL of 0.10 M NH_4Cl. Neglecting the differences between activities and concentrations, the resulting solution:
A) has a pH = 4.74
B) has a $[H^+]$ of approximately 10^{-3} M
C) has a $[NH_4^+]$ greater than that of the $NH_4Cl(aq)$
D) has an $[OH^-]$ of 1.8×10^{-5} M
E) is acidic
Answer: D
Diff: 2 Type: MC
Reference: Section 17-1

11) In 0.100 M $HC_2H_3O_2(aq)$, $[H_3O^+(aq)] = [C_2H_3O_2^-(aq)] = 1.3 \times 10^{-3}$ M. If a few drops of concentrated HCl(aq) are added to this solution, the $C_2H_3O_2^-(aq)$ concentration is:
A) $< 1.3 \times 10^{-3}$ M
B) $> 1.3 \times 10^{-3}$ M
C) $= 1.3 \times 10^{-3}$ M
D) 0.100 M
Answer: A
Diff: 2 Type: MC
Reference: Section 17.1

12) Which of the following can act as buffer solutions?
I) 0.1 M $HC_2H_3O_2$/0.1 M $NaC_2H_3O_2$
II) 0.1 M NH_3/0.1 M NH_4Cl
III) 0.1 M HNO_3/0.1 M $NaNO_3$
IV) 0.1 M H_2SO_3/0.1 M $NaHSO_3$
V) 0.1 M $KHSO_4$/ 0.1 M H_2SO_4
A) I), II), and III)
B) II), III) and IV)
C) III) and IV)
D) I), II) and IV)
E) III), IV) and V)
Answer: D
Diff: 2 Type: MC
Reference: Section 17-2

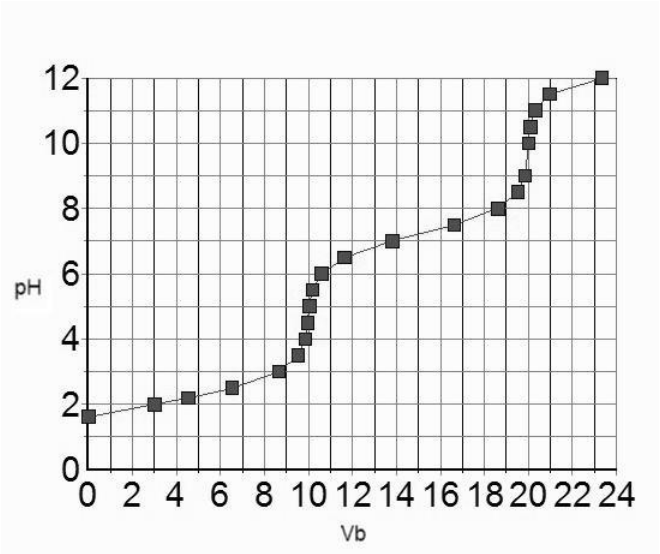
13) The Henderson-Hasselbach equation, used to calculate the pH of simple conjugate-pair buffer systems, would be expressed for an ammonia/ammonium chloride buffer, for which $K_b(NH_3)$ is 1.8×10^{-5}, as:
A) $pH = 4.74 + \log([NH_3]/[NH_4^+])$
B) $pH = 4.74 + \log([NH_4^+]/[NH_3])$
C) $pH = 9.25 + \log([NH_3]/[NH_4^+])$
D) $pH = 9.25 + \log([NH_4^+]/[NH_3])$
E) $pH = 14.0 - \log(1.8 \times 10^{-5})$
Answer: C
Diff: 2 Type: MC
Reference: Section 17-2

14) What is the buffer range (for an effective 2.0 pH unit) for a benzoic acid/sodium benzoate buffer? [Ka for benzoic acid is 6.3×10^{-5}]
A) 8.8 - 10.8
B) 7.4 - 9.4
C) 5.3 - 7.3
D) 4.7 - 6.7
E) 3.2 - 5.2
Answer: E
Diff: 3 Type: MC
Reference: Section 17-2

15) Which of the following mixtures would you dismiss as a potential buffer in a laboratory?
A) mixing equal volumes of 0.10 M $NaC_2H_3O_2$(aq) and 0.10 M HCl(aq).
B) mixing equal volumes of 0.10 M $NaC_2H_3O_2$(aq) and 0.050 M HCl(aq).
C) mixing equal volumes of 0.10 M $NaC_2H_3O_2$(aq) and 0.10 M $HC_2H_3O_2$(aq).
D) mixing equal volumes of 0.10 M $HC_2H_3O_2$(aq) and 0.050 M NaOH(aq).
Answer: A
Diff: 2 Type: MC

Reference: Section 17.2

16) The following compounds are available as 0.10 M aqueous solutions: pyridine (pK_b = 8.82), triethylamine (pK_b = 3.25), $HClO_4$, NaOH, phenol (pK_a = 9.96), HClO (pK_a = 7.54), and NH_3 (pK_b = 4.74). Identify two solutions that could be used to prepare a buffer with a pH of approximately 5.
A) pyridine and $HClO_4$
B) triethyamine and $HClO_4$
C) phenol and NaOH
D) HClO and NaOH
Answer: A
Diff: 3 Type: MC
Reference: Section 17.2
17) The titration curve for 10.0 mL of 0.100 M H_3PO_4(aq) with 0.100 M NaOH(aq) is given below.



Estimate the pK_{a2} of H_3PO_4.
A) 7.2
B) 4.8
C) 9.8
D) 2.2
Answer: A
Diff: 2 Type: MC
Reference: Section 17.4

18) What is the pH of a 0.30 M trisodium phosphate solution? [K_a for monohydrogen phosphate ion is 4.2×10^{-13}]
A) 13.3
B) 12.9
C) 10.5
D) 9.8
E) 8.6
Answer: B
Diff: 1 Type: BI

Reference: Section 17-5

19) What is the pH of a 1.0 M solution of Na_3AsO_4?($K_{a1} = 6 \times 10^{-3}$, $K_{a2} = 1 \times 10^{-7}$, $K_{a3} = 3 \times 10^{-12}$)
A) 2.5
B) 7.0
C) 8.2
D) 11.5
E) 5.8
Answer: C
Diff: 2 Type: BI
Reference: Section 17-5

20) What is the pH of a 1.0 M solution of Na_2SO_3? $K_{a1} = 1.3 \times 10^{-2}$, $K_{a2} = 6.2 \times 10^{-8}$?
A) 6.8
B) 7.2
C) 7.0
D) 10.4
E) 3.6
Answer: D
Diff: 2 Type: BI
Reference: Section 17-5

21) What is the pH of a 1.0 M solution of trisodium phosphate? $K_{a1} = 7.1 \times 10^{-3}$, $K_{a2} = 6.3 \times 10^{-8}$, $K_{a3} = 4.2 \times 10^{-13}$
A) 1.6
B) 7.0
C) 12.4
D) 6.2
E) 7.8
Answer: E
Diff: 2 Type: BI
Reference: Section 17-5

22) Calculate the pH of an aqueous solution that is 1.0 M Na_2CO_3. K_{a2} for H_2CO_3 is 4.7×10^{-11}.
A) 8.8
B) 10.3
C) 3.7
D) 12.2
E) 1.8
Answer: D
Diff: 2 Type: BI
Reference: Section 17-5

***General Chemistry*, 10e Cdn (Petrucci)**
Chapter 18 Solubility and Complex-Ion Equilibria

1) Some solid in a solution at equilibrium means the solution is saturated.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 18-1

2)If Q_{sp} is larger than K_{sp}, precipitation should occur.
Answer: TRUE
Diff: 2 Type: TF
Reference: Section 18-5

3)Qualitative cation analysis has been replaced in recent years by instrumental analysis.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 18-9

4)A small amount of solid calcium hydroxide is shaken vigorously in a test tube almost full of water until no further change occurs and most of the solid settles out. The resulting solution is:
A) concentrated and saturated
B) dilute and saturated
C) dilute and unsaturated
D) dilute and supersaturated
E) concentrated and supersaturated
Answer: B
Diff: 1 Type: MC
Reference: Section 18-1

5)The molar solubility of $SrSO_4$ ($K_{sp} = 7.6 \times 10^{-7}$) is:
A) 2.8×10^{-5} M
B) 7.6×10^{-7} M
C) 8.7×10^{-8} M
D) 8.7×10^{-4} M
E) 9.1×10^{-3} M
Answer: D
Diff: 1 Type: MC
Reference: Section 18-2

6)What is the molar solubility of barium carbonate in pure water? ($K_{sp} = 5.1 \times 10^{-9}$)
A) 5.1×10^{-9} M
B) 7.1×10^{-5} M
C) 1.1×10^{-3}
D) 1.7×10^{-3}
E) 2.6×10^{-17}
Answer: B
Diff: 1 Type: MC

Reference: Section 18-2

7) A saturated solution of magnesium fluoride has a concentration of 1.17×10^{-3} M. For this compound, K_{sp} =
A) 1.17×10^{-3}
B) $(1.17 \times 10^{-3})^2$
C) $4(1.17 \times 10^{-3})^3$
D) $(1.17 \times 10^{-3})^3$
E) $3(1.17 \times 10^{-3})^3$
Answer: C
Diff: 1 Type: MC
Reference: Section 18-2

8) The solubility of copper(II) iodate $Cu(IO_3)_2$ is reported as 0.12 g per 100 mL. What is the solubility product constant for this salt?
A) 9.8×10^{-8}
B) 8.6×10^{-7}
C) 7.3×10^{-6}
D) 6.4×10^{-5}
E) 1.2×10^{-4}
Answer: A
Diff: 2 Type: MC
Reference: Section 18-2

9) The solubility product constant of Li_3PO_4 is 3.2×10^{-9}. What is the molar solubility of Li_3PO_4 in water?
A) 3.3×10^{-3} M
B) 9.3×10^{-4} M
C) 7.5×10^{-3} M
D) 1.5×10^{-3} M
E) 5.7×10^{-5} M
Answer: A
Diff: 2 Type: MC
Reference: Section 18-2

10) The solubility product constant of silver sulfate is 1.6×10^{-5}. What is the molar solubility of this compound?
A) 1.6×10^{-5}
B) $(16/2)^{1/2} \times 10^{-2}$
C) $(16/4)^{1/3} \times 10^{-2}$
D) $(16)^{1/2} \times 10^{-3}$
E) $(16/4)^{2/3} \times 10^{-2}$
Answer: C
Diff: 2 Type: MC
Reference: Section 18-2

11) The solubility of a salt MX_2 with a molar mass of 170 g/mol is 12.7 g/liter. Calculate the K_{sp}.
A) 4.17×10^{-4}
B) 5.58×10^{-3}
C) 9.59×10^{3}
D) 2.23×10^{-2}
E) 1.67×10^{-3}
Answer: E
Diff: 2 Type: MC
Reference: Section 18-2

12) When solid silver chloride is shaken with a 0.1 molar solution of potassium iodide, most of the silver chloride is converted to silver iodide. This transformation takes place because:
A) silver iodide is less soluble than silver chloride
B) I^- is a better reducing agent than Cl^-
C) I^- has a larger radius than Cl^-
D) the K_{sp} of AgI is larger than the K_{sp} of AgCl
E) potassium chloride precipitates
Answer: A
Diff: 2 Type: MC
Reference: Section 18-2

13) Which of the following should dissolve the smallest amount of silver sulfide per liter, assuming no complex formation?
A) 0.1 M HNO_3
B) 0.1 M Na_2S
C) 0.1 M $AgNO_3$
D) 0.10 M $NaNO_3$
E) pure water
Answer: C
Diff: 1 Type: MC
Reference: Section 18-3

14) Predict the molar solubility of the following salt in a solution that contains the given concentration of one of its ions:
AgI; $[I^-] = 7.2 \times 10^{-6}$ M; $K_{sp} = 8.5 \times 10^{-17}$
A) 2.4×10^{-11}
B) 9.2×10^{-9}
C) 1.7×10^{-6}
D) 2.7×10^{-4}
E) 1.2×10^{-11}
Answer: E
Diff: 2 Type: MC
Reference: Section 18-3

15) What is the molar solubility of PbI_2 ($K_{sp} = 7.1 \times 10^{-9}$) in 0.10 M $Pb(NO_3)_2$?

A) 1.3×10^{-4} M
B) 2.6×10^{-3} M
C) 7.1×10^{-8} M
D) 2.7×10^{-4} M
E) 2.7×10^{-5} M
Answer: A
Diff: 2 Type: MC
Reference: Section 18-3

16) When 100 mL each of 2.0×10^{-6} M Ag^+ and 2.0×10^{-3} M Br^- are mixed, what is the remaining Ag^+ ion concentration and is precipitation complete? The solubility product constant of AgBr is 5.0×10^{-13}.
A) 7.1×10^{-7}, no
B) 5.0×10^{-10}, yes
C) 1.0×10^{-3}, no
D) 5.0×10^{-13}, yes
E) 2.5×10^{-10}, yes
Answer: B
Diff: 3 Type: MC
Reference: Section 18-5

17) In which of the following one molar solutions would you expect cadmium sulfide, CdS, to be the most soluble?
A) NaCl
B) HCl
C) NaOH
D) C_2H_5OH
E) KOH
Answer: B
Diff: 2 Type: MC
Reference: Section 18-7

18) The solubility product constant of $Mg(OH)_2$ is 9.0×10^{-12}. If a solution is 0.010 M with respect to Mg^{2+} ion, the amount of $[OH^-]$ required to start the precipitation of $Mg(OH)_2$ is:
A) 1.5×10^{-7}
B) 3.0×10^{-5} M
C) 3.0×10^{-7} M
D) 9.0×10^{-10}
E) 1.5×10^{-5} M
Answer: B
Diff: 1 Type: MC
Reference: Section 18-7

19) To a concentrated buffer of pH 9.0 was added an equal volume of a solution that was 0.20 M in each of the ions Ca^{2+}, Cd^{2+}, and Cu^{2+}. The expected precipitate would consist of:

salt:	calcium hydroxide	cadmium hydroxide	copper(II) hydroxide
K_{sp}:	4.0×10^{-6}	2.0×10^{-14}	1.8×10^{-19}

A) only $Ca(OH)_2$
B) only $Cd(OH)_2$
C) only $Cu(OH)_2$
D) only $Cd(OH)_2$ and $Cu(OH)_2$
E) $Ca(OH)_2$, $Cd(OH)_2$, and $Cu(OH)_2$
Answer: D
Diff: 3 Type: MC
Reference: Section 18-7

20) If chromium(III) chloride is added to be 1×10^{-12} M in a solution that is 0.10 M NH_3, what is Q_{sp} and will $Cr(OH)_3$ precipitate? The K_{sp} of $Cr(OH)_3$ is 6.3×10^{-31} and K_b for NH_3 is 1.8×10^{-5}.
A) 1.0×10^{-16}, yes
B) 2.4×10^{-23}, no
C) 2.2×10^{-19}, no
D) 2.2×10^{-19}, yes
E) 2.4×10^{-21}, yes
Answer: E
Diff: 3 Type: MC
Reference: Section 18-7

21) What is the concentration of free Zn^{2+} if 0.020 M Zn^{2+} solution is mixed with an equal volume of 2.0 M NH_3? K_f for $[Zn(NH_3)_4]^{2+}$ is 4.1×10^8.
A) 2.5×10^{-11}
B) 2.9×10^{-11}
C) 1.7×10^{-10}
D) 9.6×10^{-11}
E) 2.4×10^{-9}
Answer: B
Diff: 1 Type: MC
Reference: Section 18-8

22) What is the free Cu^{2+} concentration if 0.020 M Cu^{2+} solution is mixed with an equal volume of 4.0 M NH_3? K_f for $[Cu(NH_3)_4]^{2+}$ is 1.1×10^{13}.
A) 5.7×10^{-15}
B) 2.8×10^{-16}
C) 6.2×10^{-17}
D) 4.5×10^{-15}
E) 1.7×10^{-16}
Answer: C
Diff: 1 Type: MC
Reference: Section 18-8

23) What is the free Ag^+ concentration of 0.020 M Ag^+ solution mixed with an equal volume of 2.0 M NH_3? K_f for $[Ag(NH_3)_2]^+$ is 1.6×10^7.

A) 1.3×10^{-10}
B) 2.0×10^{-14}
C) 6.3×10^{-8}
D) 6.5×10^{-10}
E) 3.1×10^{-10}
Answer: D
Diff: 1 Type: MC
Reference: Section 18-8

24) Equal volumes of a 0.020 M Zn^{2+} solution and a 2.0 M NH_3 solution are mixed. K_f for $[Zn(NH_3)_4]^{2+}$ is 4.1×10^8. If enough sodium oxalate is added to make the solution 0.10 M in oxalate, will ZnC_2O_4 precipitate? What is Q? K_{sp} $ZnC_2O_4 = 2.7 \times 10^{-8}$
A) yes, $Q = 11$
B) yes, $Q = 2.9 \times 10^{-12}$
C) no, $Q = 2.9 \times 10^{-12}$
D) yes, $Q = 2.4 \times 10^{-9}$
E) no, $Q = 2.4 \times 10^{-9}$
Answer: C
Diff: 3 Type: MC
Reference: Section 18-8

25) What is the composition of the precipitate formed when H_2S gas is bubbled through 1.0 litre of a solution of 0.010 M Zn^{2+}, 0.010 M Pb^{2+}, and 0.010 M Mn^{2+}, buffered at pH 2.0, until 0.10 mol of H_2S has been added? [K_{sp} values are: ZnS: 1.6×10^{-23}; MnS: 7.0×10^{-16}; PbS: 7.0×10^{-29}. For H_2S, $K_{a1} = 1.0 \times 10^{-7}$; $K_{a2} = 1.3 \times 10^{-13}$.
A) only ZnS
B) only MnS
C) only PbS
D) only MnS and PbS
E) only ZnS and PbS
Answer: E
Diff: 3 Type: MC
Reference: Section 18-9

26) Write the solubility product constant for $KAl(SO_4)_2(s)$?
A) $([K^+] \times [Al^{3+}] \times 2[SO_4^{2-}]/[KAl(SO_4)_2])$
B) $([K^+] \times [Al^{3+}] \times [SO_4^{2-}]/[KAl(SO_4)_2])$
C) $([K^+] \times [Al^{3+}] \times [SO_4^{2-}])$
D) $([K^+] \times [Al^{3+}] \times [SO_4^{2-}]^2)$
E) none of these
Answer: D
Diff: 1 Type: BI
Reference: Section 18-1

27) In a qualitative cation analysis, the unknown ion is not precipitated by HCl, H_2S, or CO_3^{2-}. A flame test produced a violet flame. The unknown ion is _____.
A) Ag^+
B) Pb^{2+}
C) Fe^{2+}
D) K^+
E) NH^{4+}
Answer: D
Diff: 2 Type: BI
Reference: Section 18-9

***General Chemistry*, 10e Cdn (Petrucci)**
Chapter 19 Spontaneous Change: Entropy and Free Energy

1) Entropy is related to the way in which the energy of a system is distributed among the available microscopic energy levels.
Answer: TRUE
Diff: 1 Type: TF
Reference: Section 19-2

2) Standard Gibbs energy of formation requires the reactants be compounds in their standard state.
Answer: FALSE
Diff: 2 Type: TF
Reference: Section 19-5

3) ΔG° is independent of temperature.
Answer: FALSE
Diff: 2 Type: TF
Reference: Section 19-7

4) A nonspontaneous reaction can be made to occur by coupling it with a spontaneous reaction to form an overall spontaneous reaction.
Answer: TRUE
Diff: 2 Type: TF
Reference: Section 19-8

5) A spontaneous process:
A) will happen quickly.
B) releases large amounts of energy.
C) requires an external action in order to begin reacting.
D) will continue on its own once begun.
E) is never endothermic.
Answer: D
Diff: 1 Type: MC
Reference: Section 19-1

6) Find correct statements.
I) A spontaneous process is a process that occurs in a system left to itself.
II) A nonspontaneous process will not occur unless some external force is applied.
III) If a reaction is spontaneous, the reverse is also spontaneous.
IV) Only spontaneous processes occur naturally.
V) Entropy is inversely proportional to the degree of randomness.
A) I), II) and V)
B) II), III), and IV)
C) I), II), and IV)
D) I), III) and IV)
E) I), IV), and V)
Answer: C
Diff: 1 Type: MC
Reference: Section 19-1

7) Which of the following statements are true?
I) Liquids have more entropy than their solids.
II) Solutions have more entropy than the solids dissolved.
III) Gases and their liquids have equal entropy.
IV) Gases have less entropy than their solids.
V) Entropy of a substance increases as its temperature increases.
A) II), III), and V)
B) I), III), and V)
C) I), IV), and V)
D) I), II), and V)
E) II), IV) and V)
Answer: D
Diff: 1 Type: MC
Reference: Section 19-2

8) Which of the following processes would result in a decrease in system entropy?
A) melting of an ice cube
B) sublimation of a moth ball
C) evaporation of a puddle of gasoline
D) a glass of cool lemonade warming in the sun
E) condensation of water vapor on a cold windshield
Answer: E
Diff: 2 Type: MC
Reference: Section 19-2

9) Choose the correct statements concerning entropy.
I) As two gasses mix, ΔS is positive.
II) Entropy is a thermodynamic property related to the degree of disorder.
III) As temperature in a gas decreases, ΔS is positive.
IV) Molecules in the liquid state have higher entropy than molecules in the gaseous state.
A) I and III
B) I, II, III
C) I and II
D) I, II, IV
E) II and III
Answer: C
Diff: 2 Type: MC
Reference: Section 19-2

10) Indicate the statement(s) which are true for the process:

$$Al^{+3}(aq) + 3\ OH^{-}(aq) \rightarrow Al(OH)_3(s)$$

if it occurs in a closed container.
I) ΔS increases because the final molecule is more complicated.
II) Entropy decreases because the product is in the solid phase.
III) The two ions achieve a high degree of order as they crystalize, therefore ΔS is positive.
IV) Entropy of the system is unchanged because the system is sealed and at a constant temperature.
A) I and II
B) I and III

C) II only
D) I, II, IV
E) I and IV
Answer: C
Diff: 2 Type: MC
Reference: Section 19-2

11) Which of the following has the largest molar entropy?
A) $I_2(g)$
B) Xe(g)
C) $H_2(g)$
D) He(g)
Answer: A
Diff: 2 Type: MC
Reference: Section 19-3

Reference: Section 19-3

12)The fact that the entropies of vaporization for liquids which exhibit hydrogen bonding are greater than the 87 J/(mol · K) which is expected of non-polar liquids is an exception to:
A) the Gibb's Energy Rule
B) the Third Law of Thermodynamics
C) the Clausius-Clapyeron Rule
D) the Second Law of Thermodynamics
E) Trouton's Rule
Answer: E
Diff: 2 Type: MC
Reference: Section 19-3

13) Choose the INCORRECT statement.
A) One form of the second law of thermodynamics is all spontaneous processes produce an increase in the entropy of the universe.
B) Gibbs energy is defined by: $G = H - TS$.
C) If $\Delta G < 0$, the process is spontaneous.
D) If $\Delta G > 0$, the process is nonspontaneous.
E) If $\Delta G = 0$, the process is spontaneous.
Answer: E
Diff: 1 Type: MC
Reference: Section 19-4

14)Choose the INCORRECT statement.
A) The third law of thermodynamics states that the entropy of a pure crystal at 298 K is zero.
B) $\Delta S^\circ = \Sigma (\nu S^\circ)_{\text{products}} - \Sigma (\nu S^\circ)_{\text{reactants}}$.
C) The activity of pure liquids or pure solids is 1.
D) $\Delta G^\circ = -RT \ln K_{eq}$.
E) $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$.
Answer: A

Diff: 1 Type: MC
Reference: Section 19-4

15) The change in Gibbs energy of a reaction:
A) = work
B) predicts speed
C) = $\Delta H + T\Delta S$
D) depends on the standard state chosen
E) tells us if the reaction is spontaneous or not
Answer: E
Diff: 2 Type: MC
Reference: Section 19-4

16) If $\Delta G < 0$ for a reaction, then the reaction is said to be:
A) endothermic
B) reversible
C) spontaneous
D) exothermic
E) fast
Answer: C
Diff: 1 Type: MC
Reference: Section 19-4

17) The maximum quantity of energy available for useful work is:
A) constant
B) Gibbs energy
C) the entropy
D) the internal energy
E) the enthalpy
Answer: B
Diff: 1 Type: MC
Reference: Section 19-4

18)The change in Gibbs energy for a reaction:
A) = $\Delta H - T\Delta S$
B) = Q (heat)
C) = $\Delta S + T\Delta H$
D) = $\Delta S - T\Delta H$
E) = $\Delta H + T\Delta S$
Answer: A
Diff: 1 Type: MC
Reference: Section 19-4

19) The Gibbs energy change for a reaction is -298 kJ. The reaction is therefore:
A) exothermic
B) irreversible
C) spontaneous
D) endothermic
E) nonspontaneous

Answer: C
Diff: 1 Type: MC
Reference: Section 19-4

20) In a sealed container, the rate of dissolving is equal to the rate of crystallization. Therefore we would expect:
A) $\Delta G < 0$
B) $\Delta G > 0$
C) $\Delta G = 0$
D) $\Delta S = 0$
E) must know ΔH to determine
Answer: C
Diff: 2 Type: MC
Reference: Section 19-4

21) A reaction is spontaneous if:
I) ΔG is a negative value
II) both enthalpy and entropy increase
III) ΔH is negative and ΔS is positive
IV) both enthalpy and entropy decrease
V) ΔH is positive and ΔS is negative
A) I and III
B) I and II
C) II and V
D) III and IV
E) II and IV
Answer: A
Diff: 2 Type: MC
Reference: Section 19-4

22) Which of the following combinations of signs for ΔH and ΔS will <u>always</u> result in a reaction being nonspontaneous?
A) ΔH^+, ΔS^-
B) ΔH^-, ΔS^+
C) ΔH^-, ΔS^-
D) ΔH^+, ΔS^+
E) cannot determine without temperature
Answer: A
Diff: 2 Type: MC
Reference: Section 19-4

23) The following reaction is endothermic.

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$$

This means the reaction:
A) will be spontaneous at high temperature
B) will be spontaneous at low temperature
C) is not spontaneous at any temperature
D) is spontaneous at all temperatures
Answer: A
Diff: 2 Type: MC
Reference: Section 19-4

24) For $Cl_2O(g) + 3/2\ O_2(g) \rightarrow 2\ ClO_2$ $\triangle H° = 126$ kJ/mol, and $\Delta S° = -74.9$ J/(mol·deg) at 377°C. What is K_{eq}?
A) 0.97
B) 6.12×10^{-7}
C) 4.27×10^{-22}
D) 9.17×10^{-15}
E) 1.07×10^{14}
Answer: D
Diff: 2 Type: MC
Reference: Section 19-6

25) Consider the reaction:

	$N_2(g)$ +	3 $X_2(g)$ →	2 $NX_3(g)$
$\triangle H°$	0.0	0.0	-43 kJ/mol
$S°$	192	210	172 J/(mol·K)

What is K_{eq} for this reaction at 591 K?
A) 2.3×10^{17}
B) 4.3×10^{-18}
C) 1.04
D) 0.96
E) 132
Answer: B
Diff: 2 Type: MC
Reference: Section 19-6

26) For the reaction $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$ at 298 K, $K_{eq} = 1.87 \times 10^{-7}$, $\Delta S° = 1.8192$ J/(mol ·K), what is $\Delta G°$ and is the reaction spontaneous?
A) 3.84×10^4 kJ/mol, no
B) 7.68 kJ/mol, no
C) -7.68 kJ/mol, yes
D) 38.4 kJ/mol, no
E) -38.4 kJ/mol, yes
Answer: D
Diff: 2 Type: MC
Reference: Section 19-6

27) If the vapor pressure of water in an open system at 25°C is 23.8 mmHg, what is ΔG for the reaction below at 25°C?

$H_2O(l) \rightarrow H_2O(g, 23.8\ mmHg)$

A) 0 kJ/mol
B) -8.58 kJ/mol
C) +8.58 kJ/mol
D) -0.720 kJ/mol
Answer: A
Diff: 3 Type: MC
Reference: Section 19-6

28) For the vaporization of water in an open system at 25°C and 1 atm, which of the following is correct?
A) The reaction is entropy driven.
B) The reaction is enthalpy driven.
C) The reaction is not spontaneous.
D) $\Delta G^\circ_{rxn} = 0$
Answer: A
Diff: 3 Type: MC
Reference: Section 19-6

29)Consider the reaction of 25.0 mL of 0.20 M $AgNO_3(aq)$ with 25.0 mL of 0.20 M NaBr(aq) to form AgBr(s) at 25°C. What is ΔG for this reaction? The K_{sp} of AgBr is 5.0×10^{-13} at 25°C.
A) -58.8 kJ/mol
B) -70.2 kJ/mol
C) +58.8 kJ/mol
D) +70.2 kJ/mol
Answer: A
Diff: 3 Type: MC
Reference: Section 19-6

30) Choose the INCORRECT statement.

A) The van't Hoff equation is $\ln \frac{K_2}{K_1} = \frac{\Delta H^\circ}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$.

B) K_{eq} is independent of temperature.
C) In a thermodynamic equilibrium constant expression, the activity of a gas is replaced by its partial pressure in atmosphere.
D) In a K_{eq} expression, the activity of a solution is replaced by its molarity.
E) If $\Delta G = 0$, the process is at equilibrium.
Answer: B
Diff: 1 Type: MC
Reference: Section 19-7

31) Calculate the temperature for which K_{eq} for a reaction is 1.04×10^3 where $\Delta H° = -83.2$ kJ/mol and $\Delta S° = -246$ J/mol · K.
A) 0.274 K
B) 307 K
C) 0.307 K
D) 274 K
E) cannot be determined without $\Delta G°$
Answer: D
Diff: 3 Type: BI
Reference: Section 19-7