

1002_2nd Exam_1010418

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

1) How will addition of sodium acetate to an acetic acid solution affect the pH?

- A) It will lower the pH.
- B) The pH cannot be measured.
- C) The solution becomes hotter.
- D) The pH will not change.
- E) It will raise the pH.

Answer: E

2) What is the $[\text{H}_3\text{O}^+]$ 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) 9.0×10^{-6} M
- B) 7.2×10^{-5} M
- C) 1.8×10^{-5} M
- D) 4.7 M
- E) 3.6×10^{-5} M

Answer: E

3) The K_a of $\text{HC}_2\text{H}_3\text{O}_2$ is 1.8×10^{-5} . Determine the $[\text{C}_2\text{H}_3\text{O}_2^-]$ of the following solution. Initial concentrations are given. $[\text{HC}_2\text{H}_3\text{O}_2] = 0.250$ M, $[\text{HI}] = 0.120$ M

- A) 3.8×10^{-5} M
- B) 1.8×10^{-5} M
- C) 0.37 M
- D) 0.25 M
- E) 8.6×10^{-6} M

Answer: A

4) If some NH_4Cl is added to an aqueous solution of NH_3 :

- A) the solution will not have pH
- B) the pH of the solution will not change
- C) the pH of the solution will decrease
- D) the pH of the solution will increase
- E) NH_4Cl cannot be added to NH_3

Answer: C

5) Which among the following pairs is inefficient as buffer pair?

- A) potassium carbonate and potassium bicarbonate
- B) ammonium chloride and ammonium hydroxide
- C) potassium bromide and hydrobromic acid
- D) sodium chloride and sodium hydroxide
- E) boric acid and sodium borate

Answer: D

6) A solution containing equimolar amounts of a weak acid with $K_a = 10^{-5}$ and its sodium salt has:

- A) $\text{pH} < 7$
- B) pH dependent on the nature of the acid anion
- C) pH is independent on concentration ratios
- D) $\text{pH} = 7$
- E) $\text{pH} > 7$

Answer: A

7) What is the buffer range (for an effective 2.0 pH unit) for a benzoic acid/sodium benzoate buffer? [K_a for benzoic acid is 6.3×10^{-5}]

- A) 7.4 - 9.4
- B) 5.3 - 7.3
- C) 8.8 - 10.8
- D) 4.7 - 6.7
- E) 3.2 - 5.2

Answer: E

8) 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) $HClO$ and NaOH
 B) pyridine and $HClO_4$
 C) triethylamine and $HClO_4$
 D) phenol and NaOH

Answer: B

9) What factor governs the selection of an indicator for a neutralization titration?

- A) the pH at the stoichiometric (equivalence) point
 B) the molarity of the standard solution
 C) the solubility of the indicator
 D) the final volume of the solution
 E) the volume of titrant

Answer: A

10) Phenol red indicator changes from yellow to red in the pH range from 6.6 to 8.0. State what color the indicator will assume in the following solution: 0.10 M $HC_2H_3O_2$

- A) red-yellow mixture
 B) red
 C) yellow
 D) The indicator is its original color.
 E) There is not enough information to answer this question.

Answer: C

11) Which of the following statements correctly describe a typical titration curve for the titration of a strong acid by a strong base?

- I) The beginning pH is low.
 II) The pH change is slow until near the equivalence point.
 III) At the equivalence point, pH changes by a large value.
 IV) The equivalence point would be at a pH less than 3.5.
 V) The equivalence point would be at a pH higher than 10.
 A) I), III) and IV)
 B) I), III) and IV)
 C) I), II) and III)
 D) II), III) and IV)
 E) III), IV) and V)

Answer: C

12) The acid H_2A has $pK_{a1} = 4.0$ and $pK_{a2} = 8.0$, which describe is true

- A) at pH 6.0, $[H_2A] = [A^{2-}]$
 B) at pH 6.0 $[H_2A] = [HA^-]$
 C) at pH 6.0 $[A^{2-}] = [HA^-]$
 D) at pH 4.0 $[A^{2-}] = [HA^-]$

Answer: A

13) The base H_2B^{2+} has $pK_{b1} = 4.0$ and $pK_{b2} = 8.0$, at pH = 10 the major specie is?

- A) B
 B) HB^+
 C) H_2B^{2+}
 D) B and H_2B^{2+}

Answer: A

- 14) A 0.1 M salt (Na_2A) solution, $\text{pH} = ?$ (H_2A $\text{p}K_{a1} = 4.0$; HA^- $\text{p}K_{a2} = 7.0$)
A) 10 B) 9 C) 8 D) 11

Answer: A

- 15) 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) unsaturated B) supersaturated C) saturated

Answer: C

- 16) Which of the following has the largest molar solubility?

- A) BaSO_4 , $K_{sp} = 1.1 \times 10^{-10}$
B) $\text{Cr}(\text{OH})_2$, $K_{sp} = 6.3 \times 10^{-11}$
C) $\text{Mg}(\text{OH})_2$, $K_{sp} = 2 \times 10^{-11}$
D) AgCl , $K_{sp} = 1.6 \times 10^{-10}$
E) $\text{Fe}(\text{OH})_3$, $K_{sp} = 4 \times 10^{-38}$

Answer: B

- 17) 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) I^- is a better reducing agent than Cl^-
B) potassium chloride precipitates
C) the K_{sp} of AgI is larger than the K_{sp} of AgCl
D) I^- has a larger radius than Cl^-
E) silver iodide is less soluble than silver chloride

Answer: E

- 18) Which of the following should dissolve the smallest amount of silver sulfide per liter, assuming no complex formation? (K_{sp} for $\text{Ag}_2\text{S} = 6 \times 10^{-51}$)

- A) 0.1 M HNO_3
B) 0.1 M AgNO_3
C) 0.1 M Na_2S
D) 0.10 M NaNO_3
E) pure water

Answer: B

- 19) Dissolution of calcium fluoride is an exothermic reaction. Which of the following reduces the solubility of calcium fluoride?

- A) decreasing the pH
B) cooling the solution
C) formation of the ion-pair CaF^+
D) presence of "uncommon ions" such as Na^+ and Cl^-
E) formation of the complex ion CaF_4^{2-}

Answer: B

20) When equal volumes of the indicated solutions are mixed, precipitation should occur only for:

salt:	K_{sp} :
barium fluoride	1.0×10^{-6}
calcium carbonate	2.8×10^{-9}
calcium fluoride	5.3×10^{-9}
magnesium fluoride	3.7×10^{-9}
silver carbonate	8.5×10^{-12}

- A) $2 \times 10^{-5} \text{ M Ag}^+ + 2 \times 10^{-5} \text{ M CO}_3^{2-}$
- B) $2 \times 10^{-3} \text{ M Ba}^{2+} + 2 \times 10^{-3} \text{ M F}^-$
- C) $2 \times 10^{-5} \text{ M Mg}^{2+} + 2 \times 10^{-6} \text{ M F}^-$
- D) $2 \times 10^{-4} \text{ M Ca}^{2+} + 2 \times 10^{-4} \text{ M CO}_3^{2-}$
- E) $2 \times 10^{-5} \text{ M Ca}^{2+} + 2 \times 10^{-3} \text{ M F}^-$

Answer: D

21) When 100 mL each of $2.0 \times 10^{-4} \text{ M Ca}^{2+}$ and $2.0 \times 10^{-2} \text{ M F}^-$ are mixed, what is the remaining Ca^{2+} ion concentration and is precipitation complete? The solubility product constant of CaF_2 is 5.3×10^{-9} .

- A) 1.7×10^{-8} , yes
- B) 5.4×10^{-5} , no
- C) 1.7×10^{-6} , yes
- D) 4.3×10^{-7} , no
- E) 5.6×10^{-4} , no

Answer: B

22) A solution contains $[\text{Ba}^{2+}] = 5.0 \times 10^{-5} \text{ M}$, $[\text{Ag}^+] = 3.0 \times 10^{-5} \text{ M}$, and $[\text{Zn}^{2+}] = 2.0 \times 10^{-7} \text{ M}$. Sodium oxalate is slowly added so that $[\text{C}_2\text{O}_4^{2-}]$ increases.

Salt	BaC_2O_4	ZnC_2O_4	$\text{Ag}_2\text{C}_2\text{O}_4$
K_{sp}	1.5×10^{-8}	1.35×10^{-9}	1.1×10^{-11}

What is the concentration of the first cation to precipitate when the second cation just begins to precipitate?

- A) 1.35×10^{-9}
- B) 1.3×10^{-6}
- C) 1.1×10^{-11}
- D) 2.2×10^{-6}
- E) 5.0×10^{-5}

Answer: D

23) In which of the following one molar solutions would you expect cadmium sulfide, CdS , to be the most soluble?

- A) HCl
- B) $\text{C}_2\text{H}_5\text{OH}$
- C) NaCl
- D) KOH
- E) NaOH

Answer: A

24) Equal volumes of a 0.020 M Zn^{2+} solution and a 2.0 M NH_3 solution are mixed. K_f for $[\text{Zn}(\text{NH}_3)_4]^{2+}$ 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 ? $K_{sp} \text{ ZnC}_2\text{O}_4 = 2.7 \times 10^{-8}$

- A) yes, $Q = 2.9 \times 10^{-12}$
- B) no, $Q = 2.4 \times 10^{-9}$
- C) yes, $Q = 2.4 \times 10^{-9}$
- D) no, $Q = 2.9 \times 10^{-12}$
- E) yes, $Q = 11$

Answer: D

- 25) A spontaneous process:
- A) will happen quickly.
 - B) is never endothermic.
 - C) requires an external action in order to begin reacting.
 - D) will continue on its own once begun.
 - E) releases large amounts of energy.

Answer: D

- 26) 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) II), III), and IV)
 - B) I), II), and IV)
 - C) I), III) and IV)
 - D) I), II) and V)
 - E) I), IV), and V)

Answer: B

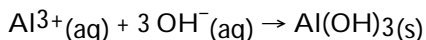
- 27) Which material has the largest entropy?
- A) crystalline salt
 - B) powdered sugar
 - C) pure water
 - D) salt water
 - E) cannot be determined

Answer: D

- 28) Which of the following processes would result in a decrease in system entropy?
- A) sublimation of a moth ball
 - B) melting of an ice cube
 - C) evaporation of a puddle of gasoline
 - D) condensation of water vapor on a cold windshield
 - E) a glass of cool lemonade warming in the sun

Answer: D

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



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) II only B) I and IV C) I and III D) I and II E) I, II, IV

Answer: A

- 30) Which of the following has the largest molar entropy?
- A) He(g)
 - B) I₂(g)
 - C) Xe(g)
 - D) H₂(g)

Answer: B

31) Which of the following quantities for an element has a value of zero in the standard state?

- I) ΔH°_f
- II) ΔG°_f
- III) S°

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

Answer: C

32) Choose the INCORRECT statement.

- A) If $\Delta G > 0$, the process is nonspontaneous.
- B) If $\Delta G < 0$, the process is spontaneous.
- C) If $\Delta G = 0$, the process is spontaneous.
- D) Gibbs energy is defined by: $G = H - TS$.
- E) One form of the second law of thermodynamics is all spontaneous processes produce an increase in the entropy of the universe.

Answer: C

33) If $\Delta G < 0$ for a reaction, then the reaction is said to be:

- A) endothermic
- B) fast
- C) exothermic
- D) reversible
- E) spontaneous

Answer: E

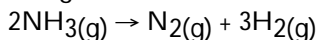
34) A reaction is spontaneous if:

- 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 II B) II and V C) III and IV D) II and IV E) I and III

Answer: E

35) The following reaction is endothermic.



This means the reaction:

- A) will be spontaneous at high temperature
- B) will be spontaneous at low temperature
- C) is spontaneous at all temperatures
- D) is not spontaneous at any temperature

Answer: A

36) For $\text{Cl}_2\text{O}(\text{g}) + 3/2 \text{O}_2(\text{g}) \rightarrow 2 \text{ClO}_2$ $\Delta H^\circ = 126 \text{ kJ/mol}$, and $\Delta S^\circ = -74.9 \text{ J/(mol}\cdot\text{deg)}$ at 377°C . What is K_{eq} ?

A) 1.07×10^{14} B) 6.12×10^{-7} C) 9.17×10^{-15} D) 0.97 E) 4.27×10^{-22}

Answer: C

37) 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 not spontaneous.
- B) The reaction is entropy driven.
- C) $\Delta G^\circ_{\text{rxn}} = 0$
- D) The reaction is enthalpy driven.

Answer: B

38) If the enthalpy of vaporization of chloromethane, CH_3Cl , is 21.5 kJ/mol at the normal boiling point, 249 K, calculate $\Delta S^\circ_{\text{vap}}$.

- A) 5.35 J mol⁻¹ K⁻¹ B) 896 J mol⁻¹ K⁻¹ C) 86.3 J mol⁻¹ K⁻¹ D) 11.6 J mol⁻¹ K⁻¹

Answer: C

39) Consider the reaction of 25.0 mL of 0.20 M $\text{AgNO}_3(\text{aq})$ with 25.0 mL of 0.20 M $\text{NaBr}(\text{aq})$ to form $\text{AgBr}(\text{s})$ at 25°C. What is ΔG for this reaction? The K_{sp} of AgBr is 5.0×10^{-13} at 25°C.

- A) -70.2 kJ/mol B) +58.8 kJ/mol C) -58.8 kJ/mol D) +70.2 kJ/mol

Answer: C

40) 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) If $\Delta G = 0$, the process is at equilibrium.

D) In a K_{eq} expression, the activity of a solution is replaced by its molarity.

E) In a thermodynamic equilibrium constant expression, the activity of a gas is replaced by its partial pressure in atmosphere.

Answer: B