1072 -2nd Chem Exam-1080508 (A)

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

1) A Brønsted-Lowry acid is defined as a substance that _____.
   A) acts as a proton acceptor
   B) decreases $[H^+]$ when placed in H_2O
   C) increases $[OH^-]$ when placed in H_2O
   D) acts as a proton donor
   E) increases K_a when placed in H_2O

   Answer: D

2) According to the Arrhenius concept, an acid is a substance that _____.
   A) is capable of donating one or more H^+
   B) can accept a pair of electrons to form a coordinate covalent bond
   C) causes an increase in the concentration of H^+ in aqueous solutions
   D) reacts with the solvent to form the cation formed by autoionization of that solvent
   E) tastes bitter

   Answer: C

3) Which statements regarding K_W are true?
   (i) pK_W is 14.00 at 25 °C
   (ii) The value of K_W is always 1.0×10^{-14}
   (iii) The value of K_W shows that water is a weak acid
   (iv) K_W changes with temperature
   (v) K_W is known as the ion product of water
   A) (i), (ii), (iii), (iv)
   B) (ii), (iii), (iv), (v)
   C) (i), (ii), (iii), (iv), (v)
   D) (i), (iii), (iv), (v)
   E) (i), (ii), (iii)

   Answer: D

4) Which one of the following is a Brønsted-Lowry base?
   A) CH_3COOH B) H_2S C) HF   D) HNO_2 E) $(CH_3)_3N$

   Answer: E

5) Which of the following aqueous solutions has the highest $[OH^-]$?
   A) a 1×10^{-3} M solution of NH_4Cl
   B) a solution with a pH of 3.0
   C) a 1×10^{-4} M solution of HNO_3
   D) pure water
   E) a solution with a pOH of 12.0

   Answer: D

6) HA is a weak acid. Which equilibrium corresponds to the equilibrium constant K_b for A^-?

   A) A^- (aq) + H_3O^+ (aq) $\rightleftharpoons$ HA (aq) + H_2O (l)

   B) A^- (aq) + OH^- (aq) $\rightleftharpoons$ HOA^{2-} (aq)

   C) HA (aq) + H_2O (l) $\rightleftharpoons$ H_2A^+ (aq) + OH^-(aq)

   D) HA (aq) + OH^- (aq) $\rightleftharpoons$ H_2O (l) + H^+ (aq)

   E) A^- (aq) + H_2O (l) $\rightleftharpoons$ HA (aq) + OH^- (aq)

   Answer: E

7) The conjugate base of $H_2PO_4^-$ is _____.

   A) PO_4^{3-} B) HPO_4^{2-} C) H_2PO_4 D) H_3PO_4 E) $H_4PO_4^+$

   Answer: B

8) The K_a of hypochlorous acid (HClO) is 3.0×10^{-8} at 25.0 °C. What is the percent ionization of hypochlorous acid in a 0.015 M aqueous solution of HClO at 25.0 °C?

   A) 1.4×10^{-3} B) 2.1×10^{-5} C) 0.14   D) 14   E) 4.5×10^{-8}

   Answer: C

9) A 0.15 M aqueous solution of the weak acid HA at 25.0 °C has a pH of 5.35. The value of K_a for HA is

   _____.

   A) 1.3×10^{-10} B) 3.0×10^{-5} C) 3.3×10^4 D) 7.1×10^{-9} E) 1.8×10^{-5}

   Answer: A

10) Using the data in the table, which of the conjugate bases below is the strongest base?

Acid	K_a
HOAc	1.8×10^{-5}
$HC_7H_5O_2$	6.3×10^{-5}
HNO_2	4.5×10^{-4}
HF	6.8×10^{-4}

   A) $C_7H_5O_2^-$ B) HOAc   C) OAc^- D) NO_2^- E) HNO_2

   Answer: C

11) Calculate the concentration (in M) of hydronium ions in a solution at 25.0 °C with a pOH of 4.223.

   A) 1.00×10^{-7}

   B) 1.67×10^4

   C) 1.67×10^{-10}

   D) 5.98×10^{-5}

   E) 5.99×10^{-19}

   Answer: C

12) A 0.1 M aqueous solution of _____ will have a pH of 7.0 at 25.0 °C.

   LiF   RbBr   NaClO$_4$ NH$_4$Cl

   A) LiF and RbBr
   B) NaClO$_4$ only
   C) RbBr only
   D) NH$_4$Cl only
   E) RbBr and NaClO$_4$

Answer: E

13) Which solution will be the most basic?
   A) 0.10 M CH$_3$OH
   B) 0.10 M Ba(OH)$_2$
   C) 0.10 M HCl
   D) 0.10 M KOH
   E) 0.10 M H$_2$O

Answer: B

14) In which of the following aqueous solutions would you expect AgBr to have the lowest solubility?
   A) 0.040 M KBr
   B) 0.040 M NaBr
   C) 0.010 M AgNO$_3$
   D) 0.040 M SrBr$_2$
   E) pure water

Answer: D

15) What is the pH of a buffer solution that is 0.172 M in hypochlorous acid (HClO) and 0.131 M in sodium hypochlorite? The K$_a$ of hypochlorous acid is 3.8×10^{-8}.
   A) 6.70   B) 7.30   C) 9.07   D) 14.12   E) 7.54

Answer: B

16) What is the molar solubility of silver carbonate (Ag$_2$CO$_3$) in water? The solubility-product constant for Ag$_2$CO$_3$ is 8.1×10^{-12} at 25 °C.
   A) 4.0×10^{-6} B) 1.3×10^{-4} C) 2.0×10^{-4} D) 1.4×10^{-6} E) 2.7×10^{-12}

Answer: B

17) What change will be caused by addition of a small amount of HCl to a solution containing fluoride ions and hydrogen fluoride?
   A) The concentration of hydronium ions will increase significantly.
   B) The concentration of fluoride ions will increase as will the concentration of hydronium ions.
   C) The fluoride ions will precipitate out of solution as its acid salt.
   D) The concentration of hydrogen fluoride will decrease and the concentration of fluoride ions will increase.
   E) The concentration of fluoride ion will decrease and the concentration of hydrogen fluoride will increase.

Answer: E

18) The solubility of lead (II) chloride (PbCl$_2$) is 1.6×10^{-2} M. What is the K$_{sp}$ of PbCl$_2$?
   A) 5.0×10^{-4} B) 1.6×10^{-5} C) 3.1×10^{-7} D) 4.1×10^{-6} E) 1.6×10^{-2}

Answer: B

19) The K_a of acetic acid is 1.76×10^{-5}. The pH of a buffer prepared by combining 15.0 mL of 1.00 M potassium acetate and 50.0 mL of 1.00 M acetic acid is _____.

    A) 0.851   B) 4.232   C) 3.406   D) 1.705   E) 2.383

Answer: B

20) A 25.0 mL sample of an HCl solution is titrated with a 0.139 M NaOH solution. The equivalence point is reached with 15.4 mL of base. The concentration of HCl is _____ M.

    A) 11.7   B) 0.00214   C) 0.139   D) 0.0856   E) 0.267

Answer: D

21) In which of the following aqueous solutions would you expect AgF to have the lowest solubility?

    A) 0.015 M KF
    B) 0.030 M LiF
    C) 0.023 M NaF
    D) 0.0075 M $AgNO_3$
    E) pure water

Answer: B

22) The pH of a solution prepared by mixing 40.0 mL of 0.125 M $Mg(OH)_2$ and 150.0 mL of 0.125 M HCl is _____.

    A) 1.14   B) 5.78   C) 1.34   D) 4.11   E) 6.29

Answer: C

23) A solution containing which one of the following pairs of substances will be a buffer solution?

    A) NaI, HI
    B) CsF, HF
    C) KBr, HBr
    D) RbCl, HCl
    E) none of the above

Answer: B

24) Of the following solutions, which has the greatest buffering capacity?

    A) 0.365M $HC_2H_3O_2$ and 0.497 M $NaC_2H_3O_2$ B) 0.121 M $HC_2H_3O_2$ and 0.116 M $NaC_2H_3O_2$
    C) 0.821 M $HC_2H_3O_2$ and 0.713 M $NaC_2H_3O_2$ D) 0.521 M $HC_2H_3O_2$ and 0.217 M $NaC_2H_3O_2$

Answer: C
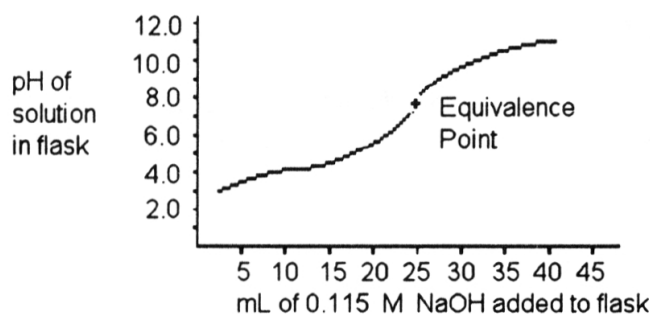
Indicator	pK_a
methyl orange	3.46
methyl red	5.00
bromocresol purple	6.12
bromthymol blue	7.10
thymol blue	8.90
phenolpthalein	9.10

pH of solution in flask

mL of 0.115 M NaOH added to flask

Equivalence Point

25) A 25.0 mL sample of a solution of a monoprotic acid is titrated with a 0.115 M NaOH solution. The titration curve above was obtained. Which of the following indicators would be best for this titration?
   A) bromocresol purple
   B) thymol blue
   C) bromthymol blue
   D) methyl red
   E) phenolpthalein

Answer: C

26) The concentration of fluoride ions in a saturated solution of barium fluoride is _____ M. The solubility product constant of BaF_2 is 1.7×10^{-6}.

   A) 7.5×10^{-3} B) 1.5×10^{-2} C) 3.0×10^{-3} D) 1.4×10^{-4} E) 3.8×10^{-4}

Answer: B

27) When a system is at equilibrium, _____.
   A) both forward and reverse processes have stopped
   B) the forward and the reverse processes are both spontaneous
   C) the process is not spontaneous in either direction
   D) the forward process is spontaneous but the reverse process is not
   E) the reverse process is spontaneous but the forward process is not

Answer: C

28) For the reaction

$$2 C_4H_{10} (g) + 13 O_2 (g) \rightarrow 8 CO_2 (g) + 10 H_2O (g)$$
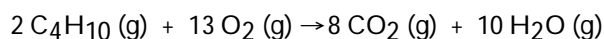
$\Delta H°$ is -125 kJ/mol and $\Delta S°$ is +253 J/K · mol. This reaction is _____.
   A) spontaneous at all temperatures
   B) spontaneous only at low temperature
   C) spontaneous only at high temperature
   D) nonspontaneous only at high temperatures
   E) nonspontaneous only at low temperature

Answer: A

29) ΔS is positive for the reaction _____.
   A) $Ag^+ (aq) + Cl^- (aq) \rightarrow AgCl (s)$
   B) $CaO (s) + CO_2 (g) \rightarrow CaCO_3 (s)$
   C) $H_2O (l) \rightarrow H_2O (s)$
   D) $2SO_3 (g) \rightarrow 2SO_2 (g) + O_2 (g)$
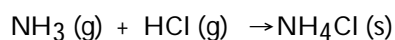   E) $N_2 (g) + 3H_2 (g) \rightarrow 2NH_3 (g)$

Answer: D

30) The normal boiling point of water is 100.0 °C and its molar enthalpy of vaporization is 40.67 kJ/mol. What is the change in entropy in the system in J/K when 24.7 grams of steam at 1 atm condenses to a liquid at the normal boiling point?

   A) -88.8   B) 373   C) -150   D) 88.8   E) -40.7

   Answer: C

31) Consider the reaction:

   $$NH_3 (g) + HCl (g) \rightarrow NH_4Cl (s)$$

   Given the following table of thermodynamic data,

Substance	$\Delta H_f°$ (kJ/mol)	$S°$ (J/mol · K)
NH_3 (g)	-46.19	192.5
HCl (g)	-92.30	186.69
NH_4Cl (s)	-314.4	94.6

   determine the temperature (in °C) above which the reaction is nonspontaneous.
   A) This reaction is spontaneous at all temperatures.
   B) 345.0
   C) 618.1
   D) 1235
   E) 432.8

   Answer: B

32) Consider the reaction:

   $$NH_3 (g) + HCl (g) \rightarrow NH_4Cl (s)$$
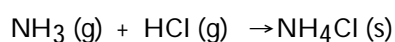
   Given the following table of thermodynamic data at 298 K:

Substance	$\Delta H_f°$ (kJ/mol)	$S°$ (J/K · mol)
NH_3 (g)	-46.19	192.5
HCl (g)	-92.30	186.69
NH_4Cl (s)	-314.4	94.6

   The value of K for the reaction at 25 °C is _____.
   A) 8.4×10^4 B) 150   C) 1.4×10^8 D) 1.1×10^{-16} E) 9.3×10^{15}

   Answer: E

33) Which one of the following processes produces a decrease of the entropy of the system?
   A) dissolving nitrogen in water
   B) sublimation of naphthalene
   C) explosion of nitroglycerine
   D) boiling of alcohol
   E) dissolving sodium chloride in water

   Answer: A

34) Of the following, the entropy of _____ is the largest.
   A) HCl (g)   B) HBr (g)   C) HI (g)   D) HCl (l)   E) HCl (s)

   Answer: C

35) The thermodynamic quantity that expresses the extent of randomness in a system is _____.
    A) enthalpy
    B) bond energy
    C) heat flow
    D) internal energy
    E) entropy
    Answer: E

36) The standard Gibbs free energy of formation of _____ is zero.

        (a) H_2O (l)
        (b) O (g)
        (c) Cl_2 (g)

    A) (a) only
    B) (b) only
    C) (c) only
    D) (b) and (c)
    E) (a), (b), and (c)
    Answer: C

37) For a reaction to be spontaneous at any condition, the signs of $\Delta H°$ and $\Delta S°$ must be _____ and _____, respectively.
    A) –, –   B) +, +   C) –, +   D) +, –   E) +, 0
    Answer: C

38) If $\Delta G°$ for a reaction is less than zero, then _____.
    A) K < 1
    B) K = 1
    C) K = 0
    D) K > 1
    E) more information is needed.
    Answer: D

39) With thermodynamics, one cannot determine _____.
    A) the value of the equilibrium constant
    B) the extent of a reaction
    C) the direction of a spontaneous reaction
    D) the speed of a reaction
    E) the temperature at which a reaction will be spontaneous
    Answer: D

40) Which one of the following is always positive when a spontaneous process occurs?
    A) ΔS_{system}
    B) $\Delta H_{universe}$
    C) $\Delta S_{surroundings}$
    D) $\Delta S_{universe}$
    E) $\Delta H_{surroundings}$
    Answer: D