1032_2nd Exam_1040422 (A)

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

1) Give the equation for a saturated solution in comparing Q with K_{sp}.
   A) $Q > K_{sp}$
   B) $Q \neq K_{sp}$
   C) $Q < K_{sp}$
   D) $Q = K_{sp}$
   E) none of the above
   Answer: D

2) Determine the pH of a solution that is 0.15 M $HClO_2$ ($K_a = 1.1 \times 10^{-2}$) and 0.15 M HClO ($K_a = 2.9 \times 10^{-8}$).
   A) 4.18 B) 3.55 C) 9.82 D) 1.39 E) 12.55
   Answer: D

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) 4.74 B) 9.11 C) 9.26 D) 4.60 E) 4.89
   Answer: D

4) Determine the molar solubility for $Al(OH)_3$ in pure water. K_{sp} for $Al(OH)_3 = 1.3 \times 10^{-33}$.
   A) 3.6×10^{-12} M
   B) 2.2×10^{-10} M
   C) 6.0×10^{-19} M
   D) 4.8×10^{-35} M
   E) 2.6×10^{-9} M
   Answer: E

5) Consider the given acid ionization constants. Identify the strongest conjugate base.

Acid	*K* a
$HNO_2(aq)$	4.6×10^{-4}
$HCHO_2(aq)$	1.8×10^{-4}
$HClO(aq)$	2.9×10^{-8}
$HCN(aq)$	4.9×10^{-10}

   A) $NO_2^-(aq)$ B) $CN^-(aq)$ C) $ClO^-(aq)$ D) $CHO_2^-(aq)$
   Answer: B

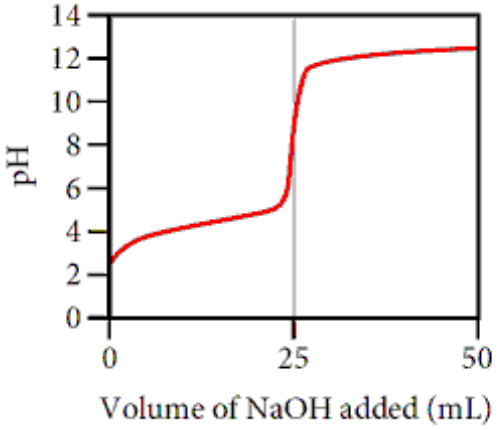
6) Consider a buffer composed of the weak acid HA and its conjugate base A^-. Which pair of concentrations results in the most effective buffer?
   A) 0.10 M HA; 0.90 M A^-
   B) 0.10 M HA; 0.10 M A^-
   C) 0.90 M HA; 0.10 M A^-
   D) 0.50 M HA; 0.50 M A^-
   Answer: D

7) Determine the $[OH^-]$ concentration of a 0.741 M KOH solution at 25°C.

A) 0.741 M
B) 7.41 M
C) 1.34×10^{-14} M
D) 1.34×10^{-13} M
E) none of the above

Answer: A

8) A weak unknown monoprotic acid is titrated with a strong base. The titration curve is shown below. Find K_a for the unknown acid.



A) 3.2×10^{-7} B) 3.2×10^{-5} C) 2.5×10^{-9} D) 2.5×10^{-3}

Answer: B

9) 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: C

10) A buffer with a pH of 9.85 contains CH_3NH_2 and CH_3NH_3Cl in water. What can you conclude about the relative concentrations of CH_3NH_2 and CH_3NH_3Cl in this buffer ? For CH_3NH_2 , $pK_b = 3.36$.

A) $CH_3NH_2 < CH_3NH_3Cl$
B) $CH_3NH_2 > CH_3NH_3Cl$
C) $CH_3NH_2 = CH_3NH_3Cl$
D) Nothing can be concluded about the relative concentrations of CH_3NH_2 and CH_3NH_3Cl.

Answer: A

11) Determine the concentration of CO_3^{2-} ions in a 0.18 M H_2CO_3 solution. Carbonic acid is a diprotic acid whose $K_{a1} = 4.3 \times 10^{-7}$ and $K_{a2} = 5.6 \times 10^{-11}$.

A) 6.9×10^{-8} M
B) 4.3×10^{-7} M
C) 3.2×10^{-6} M
D) 2.8×10^{-4} M
E) 5.6×10^{-11} M

Answer: E

12) Determine the pH of a 0.461 M $C_6H_5CO_2H$ M solution if the K_a of $C_6H_5CO_2H$ is 6.5×10^{-5}.

A) 4.52 B) 11.74 C) 5.48 D) 2.26 E) 9.48

Answer: D

13) A 100.0 mL sample of 0.18 M $HClO_4$ is titrated with 0.27 M LiOH. Determine the pH of the solution after the addition of 66.67 mL of LiOH (this is the equivalence point).

A) 2.76 B) 0.97 C) 7.00 D) 13.03 E) 11.24

Answer: C

14) A 20.0 mL sample of 0.150 M ethylamine is titrated with 0.0981 M HCl. What is the pH after the addition of 5.0 mL of HCl? For ethylamine, $pK_b = 3.25$.

A) 2.96 B) 11.04 C) 11.46 D) 10.75

Answer: C

15) 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) 9.26 B) 4.74 C) 9.06 D) 9.45 E) 4.55

Answer: C

16) Which of the following acids will have the strongest conjugate base?

A) HI B) $HClO_4$ C) HCl D) HNO_3 E) HCN

Answer: E

17) A solution containing $CaCl_2$ is mixed with a solution of $Li_2C_2O_4$ to form a solution that is 3.5×10^{-4} M in calcium ion and 2.33×10^{-4} M in oxalate ion. What will happen once these solutions are mixed? K_{sp} (CaC_2O_4) = 2.3×10^{-9}.

A) Nothing will happen $K_{sp} > Q$ for all possible precipitants.
B) Nothing will happen since both calcium chloride and lithium oxalate are soluble compounds.
C) A precipitate will form since $Q > K_{sp}$ for calcium oxalate.
D) A precipitate will form as calcium oxalate is not soluble to any extent.
E) There is not enough information to determine.

Answer: C

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

A) 3.46 B) 0.70 C) 4.15 D) 1.00 E) 2.08

Answer: E

19) 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 100.0 mL of HNO_3. The K_b of NH_3 is 1.8×10^{-5}.

A) 3.44 B) 5.28 C) 8.72 D) 10.56 E) 6.58

Answer: B

20) Determine the pH in a 0.235 M NaOH solution.

A) 0.24 B) 0.63 C) 13.76 D) 12 E) 13.37

Answer: E

21) Which combination is the best choice to prepare a buffer with a pH of 9.0?

A) C_5H_5N ; C_5H_5NHCl (pK_b for C_5H_5N is 8.76)
B) $HCHO_2$; $NaCHO_2$ (pK_a for $HCHO_2$ is 3.74)
C) HNO_2 ; $NaNO_2$ (pK_a for HNO_2 is 3.33)
D) NH_3 ; NH_4Cl (pK_b for NH_3 is 4.75)

Answer: D

22) Calculate the pH of a solution formed by mixing 200.0 mL of 0.30 M HClO with 100.0 mL of 0.20 M KClO. The K_a for HClO is 2.9×10^{-8}.

A) 6.46 B) 5.99 C) 7.54 D) 8.01 E) 7.06

Answer: E

23) Determine the pH of a 0.62 M NH_4NO_3 solution at 25°C. The K_b for NH_3 is 1.76×10^{-5}.

A) 9.27 B) 4.73 C) 11.52 D) 9.45 E) 2.48

Answer: B

24) A 10.0 mL sample of 0.200 M hydrocyanic acid (HCN) is titrated with 0.0998 M NaOH. What is the pH at the equivalence point? For hydrocyanic acid, $pK_a = 9.31$.

A) 7.00 B) 9.31 C) 8.76 D) 11.07

Answer: D

25) Determine the $[H_3O^+]$ in a 0.265 M HClO solution. The K_a of HClO is 2.9×10^{-8}.

A) 1.1×10^{-10} M
B) 4.9×10^{-4} M
C) 1.3×10^{-6} M
D) 7.7×10^{-9} M
E) 8.8×10^{-5} M

Answer: E

26) A 500.0 mL buffer solution is 0.10 M in benzoic acid and 0.10 M in sodium benzoate and has an initial pH of 4.19. What is the pH of the buffer upon addition of 0.010 mol of NaOH?

A) 4.29 B) 1.70 C) 4.37 D) 4.01

Answer: C

27) Find the percent ionization of a 0.337 M HF solution. The K_a for HF is 3.5×10^{-4}.

A) 1.2×10^{-2} % B) 3.5×10^{-2} % C) 1.1 % D) 4.7 % E) 3.2 %

Answer: E

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

Answer: D

29) A 100.0 mL sample of 0.18 M $HClO_4$ is titrated with 0.27 M LiOH. Determine the pH of the solution after the addition of 30.0 mL of LiOH.

A) 1.12 B) 2.86 C) 2.00 D) 0.86 E) 1.21

Answer: A

30) Which pair is a Brϕnsted–Lowry conjugate acid–base pair?

A) H_3O^+; OH^- B) HCl ; HBr C) ClO_4^- ; ClO_3^- D) NH_3 ; NH_4^+

Answer: D

31) A 1.50 L buffer solution is 0.250 M in HF and 0.250 M in NaF. Calculate the pH of the solution after the addition of 0.100 moles of solid NaOH. Assume no volume change upon the addition of base. The K_a for HF is 3.5×10^{-4}.

A) 3.82 B) 3.22 C) 3.69 D) 3.09 E) 4.46

Answer: C

32) 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 200.0 mL of HNO_3. The K_b of NH_3 is 1.8×10^{-5}.

A) 12.00 B) 12.52 C) 2.00 D) 1.48 E) 6.44

Answer: D

33) Determine the pH of a 0.188 M NH_3 solution at 25°C. The K_b of NH_3 is 1.76×10^{-5}.

A) 12.656 B) 5.480 C) 11.260 D) 8.520 E) 2.740

Answer: C

34) Which of the following is NOT a conjugate acid-base pair?

A) H_3O^+/OH^-
B) $C_2H_3O_2^-/HC_2H_3O_2$
C) NH_4^+/NH_3
D) H_2SO_3/HSO_3^-
E) All of the above are conjugate acid-base pairs.

Answer: A

35) Which of the following solutions would have the highest pH? Assume that they are all 0.10 M in acid at 25 °C. The acid is followed by its K_a value.

A) HF, 3.5×10^{-4}

B) HCN, 4.9×10^{-10}

C) $HCHO_2$, 1.8×10^{-4}

D) $HClO_2$, 1.1×10^{-2}

E) HNO_2, 4.6×10^{-4}

Answer: B

36) A 1.00 L buffer solution is 0.250 M in HF and 0.250 M in NaF. Calculate the pH of the solution after the addition of 100.0 mL of 1.00 M HCl. The K_a for HF is 3.5×10^{-4}.

A) 3.82 B) 2.78 C) 4.11 D) 3.46 E) 3.09

Answer: E

37) Place the following in order of increasing acid strength.

$HBrO_2$ $HBrO_3$ HBrO $HBrO_4$

A) $HBrO_2 < HBrO_4 < HBrO < HBrO_3$

B) $HBrO < HBrO_2 < HBrO_3 < HBrO_4$

C) $HBrO < HBrO_4 < HBrO_3 < HBrO_2$

D) $HBrO_2 < HBrO_3 < HBrO_4 < HBrO$

E) $HBrO_4 < HBrO_2 < HBrO_3 < HBrO$

Answer: B

38) Which of the following bases is the STRONGEST? The base is followed by its K_b.

A) CH_3NH_2, 4.4×10^{-4}

B) C_5H_5N, 1.7×10^{-9}

C) $C_6H_5NH_2$, 4.0×10^{-10}

D) $(CH_3CH_2)_2NH$, 8.6×10^{-4}

E) NH_3, 1.76×10^{-5}

Answer: D

39) In a triprotic acid, which K_a has the highest value?

A) K_{a3} B) K_{a1} C) K_{a2} D) K_{b2} E) K_{b1}

Answer: B

40) Which acid has the largest K_a : $HClO_2(aq)$, $HBrO_2(aq)$, or $HIO_2(aq)$?

A) $HIO_2(aq)$ B) $HClO_2(aq)$

C) All three acids have the same K_a. D) $HBrO_2(aq)$

Answer: B