1082–2nd Chem Exam(A)–1090513

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

1) Which one of the following is a Brønsted–Lowry base?
   A) CH_3COOH
   B) $(CH_3)_3N$
   C) HNO_2
   D) HF
   E) none of the above

   Answer: B

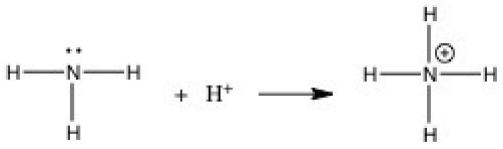
2) Which one of the following statements regarding K_W is false?
   A) K_W is known as the ion product of water.
   B) pK_W is 14.00 at 25 °C.
   C) The value of K_W is always 1.0×10^{-14}.
   D) K_W changes with temperature.
   E) The value of K_W shows that water is a weak acid.

   Answer: C

3) The hydride ion, H^-, is a stronger base than the hydroxide ion, OH^-. The product(s) of the reaction of hydride ion with water is/are _____.
   A) OH^- (aq) + $2H^+$ (aq)
   B) H_3O^+ (aq)
   C) no reaction occurs
   D) H_2O_2 (aq)
   E) OH^- (aq) + H_2 (g)

   Answer: E

4) In the gas phase reaction below, NH_3 is acting as a(n) _____.



   A) Brønsted–Lowry acid
   B) Arrhenius acid
   C) Lewis base
   D) Lewis acid
   E) Brønsted–Lowry base

   Answer: C

5) Of the acids in the table below, _____ is the strongest acid.

Acid	K_a
HOAc	1.8×10^{-5}
$HCHO_2$	1.8×10^{-4}
HClO	3.0×10^{-8}
HF	6.8×10^{-4}

A) HClO
B) $HCHO_2$
C) HF
D) HOAc
E) HOAc and $HCHO_2$

Answer: C

6) A substance that is capable of acting as both an acid and as a base is _____.
A) miscible B) conjugated C) autosomal D) amphiprotic E) saturated

Answer: D

7) 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) 4.5×10^{-8} B) 0.14 C) 2.1×10^{-5} D) 14 E) 1.4×10^{-3}

Answer: B

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

Answer: A

9) A 0.5 M solution of _____ has a pH of 7.0.
A) NaF B) K_2S C) KNO_3 D) KF E) NH_4Br

Answer: C

10) What is the pH of a 0.40 M aqueous solution of NH_4Br at 25.0 °C? K_b for NH_3 is 1.8×10^{-5}.
A) 9.18 B) 2.57 C) 11.43 D) 11.23 E) 4.82

Answer: E

11) Of the compounds below, a 0.1 M aqueous solution of _____ will have the highest pH.
A) NaHS, K_b of $HS^- = 1.8 \times 10^{-7}$
B) NaClO, K_a of HClO = 3.2×10^{-8}
C) NaOAc, K_a of HOAc = 1.8×10^{-5}
D) NH_4NO_3, K_b of $NH_3 = 1.8 \times 10^{-5}$
E) KCN, K_a of HCN = 4.0×10^{-10}

Answer: E

12) A^- is a weak base. Which equilibrium corresponds to the equilibrium constant K_a for HA?

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

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

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

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

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

Answer: D

13) The pH of an aqueous solution at 25.0 °C is 10.55. What is the molarity of H^+ in this solution?

A) 3.45 B) 2.8×10^{-11} C) 1.1×10^{-13} D) 3.5×10^{10} E) 3.5×10^{-4}

Answer: B

14) A 1.0×10^{-2} M aqueous solution of $Ca(OH)_2$ at 25.0 °C has a pH of _____.

A) 2.0×10^{-2} B) 1.70 C) 12.00 D) 5.0×10^{-13} E) 12.30

Answer: E

15) Which one of the following pairs cannot be mixed together to form a buffer solution?

A) KOH, HF

B) NH_3, NH_4Cl

C) RbOH, HBr

D) $NaC_2H_3O_2$, HCl ($C_2H_3O_2^-$ = acetate)

E) H_3PO_4, KH_2PO_4

Answer: C

16) The Henderson–Hasselbalch equation is _____.

A) $[H^+] = K_a + \frac{[base]}{[acid]}$

B) $pH = \log \frac{[acid]}{[base]}$

C) $pH = pK_a - \log \frac{[base]}{[acid]}$

D) $pH = pK_a + \log \frac{[acid]}{[base]}$

E) $pH = pK_a + \log \frac{[base]}{[acid]}$

Answer: E

17) The addition of KOH and _____ to water produces a buffer solution.

A) KF

B) NH_3

C) $LiC_2H_3O_2$

D) HI

E) none of the above

Answer: E

18) A result of the common–ion effect is _____.

A) that common ions precipitate all counter–ions

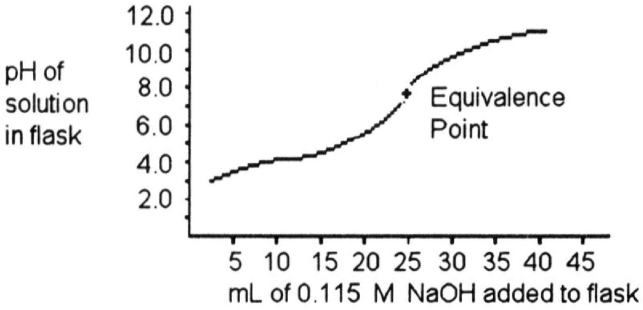
B) that some ions, such as $Na^+_{(aq)}$, frequently appear in solutions but do not participate in solubility equilibria

C) that ions such as K^+ and Na^+ are common ions, so that their values in equilibrium constant expressions are always 1.00

D) that the selective precipitation of a metal ion, such as Ag^+, is promoted by the addition of an appropriate counterion (X^-) that produces a compound (AgX) with a very low solubility

E) that common ions, such as $Na^+_{(aq)}$, don't affect equilibrium constants

Answer: D



19) A 25.0 mL sample of a solution of an unknown compound is titrated with a 0.115 M NaOH solution. The titration curve above was obtained. The unknown compound is _____.

A) a strong acid

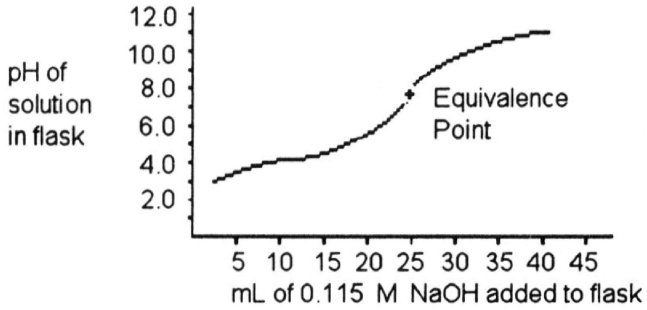
B) a strong base

C) a weak base

D) a weak acid

E) neither an acid nor a base

Answer: D



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

20) 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) thymol blue

B) bromthymol blue

C) methyl red

D) phenolpthalein

E) bromocresol purple

Answer: B

Consider the following table of K_{sp} values.

Name	Formula	K_{sp}
Cadmium carbonate	$CdCO_3$	5.2×10^{-12}
Cadmium hydroxide	$Cd(OH)_2$	2.5×10^{-14}
Calcium fluoride	CaF_2	3.9×10^{-11}
Silver iodide	AgI	8.3×10^{-17}
Zinc carbonate	$ZnCO_3$	1.4×10^{-11}

21) Which compound listed below has the greatest molar solubility in water?
A) CaF_2 B) AgI C) $ZnCO_3$ D) $Cd(OH)_2$ E) $CdCO_3$

Answer: A

22) In which one of the following solutions is silver chloride the most soluble?
A) pure H_2O
B) 0.750 M $LiNO_3$
C) 0.0150 M NH_3
D) 0.200 M HCl
E) 0.185 M KCl

Answer: C

23) Which one of the following is <u>not</u> amphoteric?
A) $Cr(OH)_3$ B) $Ca(OH)_2$ C) $Sn(OH)_2$ D) $Al(OH)_3$ E) $Zn(OH)_2$

Answer: B

24) The K_a of benzoic acid is 6.30×10^{-5}. The pH of a buffer prepared by combining 50.0 mL of 1.00 M potassium benzoate and 50.0 mL of 1.00 M benzoic acid is _____.
A) 4.201 B) 1.705 C) 2.383 D) 0.851 E) 3.406

Answer: A

25) 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) 3.0×10^{-3} B) 1.5×10^{-2} C) 7.5×10^{-3} D) 1.4×10^{-4} E) 3.8×10^{-4}

Answer: B

26) Calculate the maximum concentration (in M) of silver ions (Ag^+) in a solution that contains 0.025 M of CO_3^{2-}. The K_{sp} of Ag_2CO_3 is 8.1×10^{-12}.
A) 1.8×10^{-5} B) 8.1×10^{-12} C) 2.8×10^{-6} D) 3.2×10^{-10} E) 1.4×10^{-6}

Answer: A

27) Calculate the percent ionization of formic acid (HCO_2H) in a solution that is 0.322 M in formic acid and 0.178 M in sodium formate ($NaHCO_2$). The K_a of formic acid is 1.77×10^{-4}.
A) 35.6 B) 0.1011 C) 1.03×10^{-3} D) 3.488 E) 10.8

Answer: B

28) Consider a solution containing 0.100 M fluoride ions and 0.126 M hydrogen fluoride. The concentration of fluoride ions after the addition of 9.00 mL of 0.0100 M HCl to 25.0 mL of this solution is _____ M. (HF Ka = 6.8×10^{-4})

A) 0.00253 B) 0.0980 C) 0.0709 D) 0.0735 E) 0.0762

Answer: C

29) The first law of thermodynamics can be given as _____.

A) $\Delta S = q_{rev}/T$ at constant temperature

B) $\Delta H°_{rxn} = \sum n\Delta H°_f$ (products) $- \sum m\Delta H°_f$ (reactants)

C) $\Delta E = q + w$

D) the entropy of a pure crystalline substance at absolute zero is zero

E) for any spontaneous process, the entropy of the universe increases

Answer: C

30) A reversible process is one that _____.

A) must be carried out at low temperature

B) happens spontaneously

C) is spontaneous in both directions

D) must be carried out at high temperature

E) can be reversed with no net change in either system or surroundings

Answer: E

31) Which one of the following correctly indicates the relationship between the entropy of a system and the number of different arrangements, W, in the system?

A) $S = kW$ B) $S = k \ln W$ C) $S = \frac{k}{W}$ D) $S = \frac{W}{k}$ E) $S = Wk$

Answer: B

32) 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) 618.1

C) 1235

D) 432.8

E) 345.0

Answer: E

33) ΔS is positive for the reaction _____.

A) $2\ KClO_3\ (s) \rightarrow 2KCl\ (s) + 3\ O_2\ (g)$

B) $2\ Ca\ (s) + O_2\ (g) \rightarrow 2\ CaO\ (s)$

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

D) $CO_2\ (g) \rightarrow CO_2\ (s)$

E) $Pb^{2+}\ (aq) + 2Cl^-\ (aq) \rightarrow PbCl_2\ (s)$

Answer: A

34) For an isothermal process, the entropy change of the surroundings is given by the equation:

A) $\Delta S = -q\ \ln T$

B) $\Delta S = q_{sys}\ T$

C) $\Delta S = q\ \ln T$

D) $\Delta S = -q_{sys}\ T$

E) $\Delta S = -q_{sys} / T$

Answer: E

35) 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 high temperature

C) spontaneous only at low temperature

D) nonspontaneous at all temperatures

E) unable to determine without more information

Answer: A

36) Given the thermodynamic data in the table below, calculate the equilibrium constant (at 298 K) for the reaction: (R = 8.314 J/mol· K)

$$2SO_2(g) + O_2\ (g) \rightleftharpoons 2\ SO_3\ (g)$$

Substance	$\Delta H_f°$ (kJ/mol)	S° (J/mol · K)
SO_2 (g)	–297	249
O_2 (g)	0	205
SO_3 (g)	–395	256

A) 2.40×10^{24}

B) 3.82×10^{23}

C) 1.06

D) 1.95

E) More data are needed.

Answer: A

37) What is the equilibrium constant for a reaction at 25 °C. The value of $\Delta G°$ is –57.5 kJ/mol.

A) 10

B) 1.2×10^{10}

C) 8.4×10^{101}

D) 1.0

E) more information is needed

Answer: B

38) Consider the reaction:

$$FeO_{(s)} + Fe_{(s)} + O_{2(g)} \rightarrow Fe_2O_{3(s)}$$

Given the following table of thermodynamic data at 298 K:

Substance	$\Delta H_f°$ (kJ/mol)	S° (J/K · mol)
$FeO_{(s)}$	–271.9	60.75
$Fe_{(s)}$	0	27.15
$O_{2(g)}$	0	205.0
$Fe_2O_{3(s)}$	–822.16	89.96

The value K for the reaction at 25 °C is _____.

A) 8.1×10^{19} B) 7.1×10^{85} C) 5.9×10^{4} D) 370 E) 3.8×10^{-14}

Answer: B

39) The normal boiling point of $C_2Cl_3F_3$ is 47.6 °C and its molar enthalpy of vaporization is 27.49 kJ/mol. What is the change in entropy in the system in J/K when 28.6 grams of $C_2Cl_3F_3$ vaporizes to a gas at the normal boiling point?

A) 4.19 B) –13.1 C) –4.19 D) 13.1 E) 27.5

Answer: D

40) For a given reaction with ΔS = –50.8 J/K–mol, the ΔG = 0 at 395 K. The value of ΔH must be _____ kJ/mol, assuming that ΔH and ΔS do not vary with temperature.

A) -7.78×10^{-3}

B) -1.29×10^{-4}

C) –20.1

D) 20.1

E) 1.29×10^{-4}

Answer: C