EQUATIONS

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$E = E^\circ - \frac{RT}{nF}\ln Q$$

Integrated Rate Laws

zero: $[A] = [A]_0 - kt$

$$\mathrm{pH} = \mathrm{p}K_a + \log\left(\frac{[A^-]}{[HA]}\right)$$

$$\Delta U = q + w \qquad \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

first: $\ln[A] = \ln[A]_0 - kt$

$$\Delta E_{H\text{-}atom} = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$$

$$\Delta G^\circ = -RT\ln K \qquad \Delta G^\circ = -nFE^\circ$$

second: $\frac{1}{[A]} = \frac{1}{[A]_0} + kt$

$E = E° - (0.0592V/n)\log Q$, $R = 8.3145$ J/(mol K), $F = 96{,}485$ C/(mol e^-), 1A = 1C/s

$t_{1/2} = 0.693/k$,

$$\ln\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Reduction half reaction	**E°(V)**
$Ag^+(aq) + e^- \rightarrow Ag(s)$	0.80
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	0.52
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	-0.76
$Mn^{2+}(aq) + 2e^- \rightarrow Mn(s)$	-1.180
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	-1.665

1. Choose the molecule or compound that exhibits dipole-dipole forces as its strongest intermolecular force.

A) H_2

B) SO_2

C) NH_3

D) CF_4

E) BCl_3

Answer: B

Diff: 2 Page Ref: 11.3

2. Choose the pair of substances that are most likely to form a homogeneous solution.

A) C_6H_{14} and $C_{10}H_{20}$

B) LiBr and C_5H_{12}

C) N_2O_4 and NH_4Cl

D) C_6H_{14} and H_2O

E) None of the pairs above will form a homogeneous solution.

Answer: A

Diff: 2 Page Ref: 11.3

3. Choose the substance with the lowest viscosity.

A) Cl_3CCCl_3

B) Cl_2CHCH_2Cl

C) $Cl_2CHCHCl_2$

D) $ClCH_2CH_2Cl$

E) Cl_3CCHCl_2

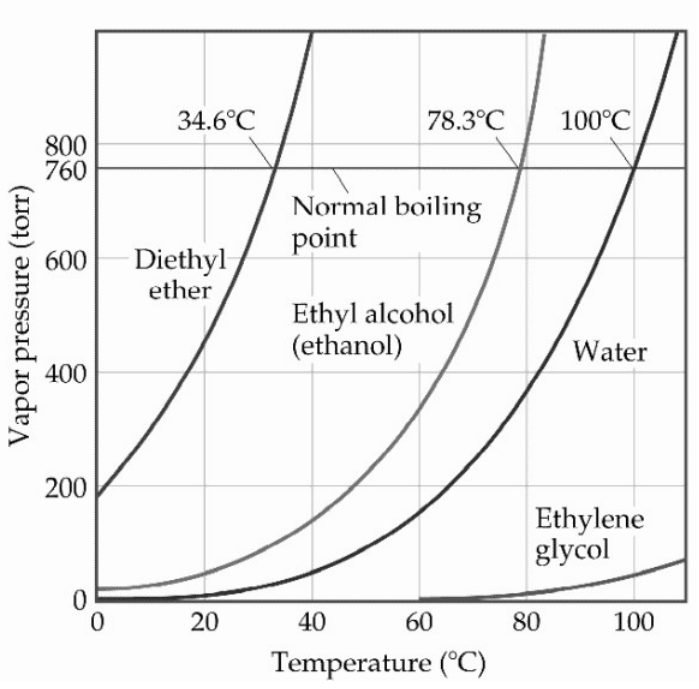
Answer: D
Diff: 2 Page Ref: 11.4

4. Place the following substances in order of **increasing** boiling point.

CH_3CH_2OH Ar CH_3OCH_3

A) Ar < CH_3OCH_3 < CH_3CH_2OH
B) CH_3CH_2OH < Ar < CH_3OCH_3
C) CH_3CH_2OH < CH_3OCH_3 < Ar
D) CH_3OCH_3 < Ar < CH_3CH_2OH
E) Ar < CH_3CH_2OH < CH_3OCH_3
Answer: A
Diff: 2 Page Ref: 11.5

5. How much energy is required to vaporize 98.6 g of ethanol (C_2H_5OH) at its boiling point, if its ΔH_{vap} is 40.5 kJ/mol?
A) 86.7 kJ
B) 11.5 kJ
C) 18.9 kJ
D) 52.8 kJ
E) 39.9 kJ
Answer: A
Diff: 3 Page Ref: 11.5



6. Determine ΔH_{vap} for a compound that has a measured vapor pressure of 24.3 torr at 273 K and 135 torr at 325 K.

A) 41 kJ/mol
B) 79 kJ/mol
C) 24 kJ/mol
D) 13 kJ/mol
E) 34 kJ/mol
Answer: C
Diff: 5 Page Ref: 11.5

7. The enthalpy change for converting 1.00 mol of ice at -50.0°C to water at 70.0°C is _____ kJ. The specific heats of ice, water, and steam are 2.09 J/gK, 4.18 J/gK, and 1.84 J/gK, respectively. For H_2O, ΔH_{fus} = 6.01 kJ/mol, and ΔH_{vap} = 40.67 kJ/mol.
A) 12.28
B) 6.41
C) 13.16
D) 7154
E) 9.40
Answer: C
Diff: 4 Page Ref: 11.7

8. Identify triple point.
A) The temperature, pressure, and density for a gas.
B) The temperature at which the boiling point equals the melting point.
C) The temperature and pressure where liquid, solid, and gas are equally stable and are in equilibrium.
D) The temperature that is unique for a substance.
E) The temperature at which the solid and liquid co-exist.
Answer: C
Diff: 1 Page Ref: 11.8

9. Why is water an extraordinary substance?
A) Water has a low molar mass, yet it is a liquid at room temperature.
B) Water is the main solvent within living organisms.
C) Water has an exceptionally high specific heat capacity.
D) Water has strong hydrogen bonding.
E) All of the above.
Answer: E
Diff: 1 Page Ref: 11.9

10. Which of the following is considered a nonbonding atomic solid?
A) Ne
B) Fe
C) I_2
D) Ca
E) Li
Answer: A
Diff: 1 Page Ref: 11.12

11. Which of the following substances should have the highest melting point?
A) Fe
B) Ne
C) Xe
D) N_2
E) CO
Answer: A
Diff: 1 Page Ref: 11.12

12. Determine the partial pressure of oxygen necessary to form an aqueous solution that is 4.1×10^{-4} M O_2 at 25°C. The Henry's law constant for oxygen in water at 25°C is 1.3×10^{-3} M/atm.
A) 1.9 atm
B) 0.53 atm
C) 0.24 atm
D) 0.77 atm
E) 0.32 atm
Answer: E
Diff: 2 Page Ref: 12.4

13. Calculate the molality of a solution formed by dissolving 27.8 g of LiI in 500.0 mL of water.
A) 0.254 *m*
B) 0.394 *m*
C) 0.556 *m*
D) 0.241 *m*
E) 0.415 *m*
Answer: E
Diff: 2 Page Ref: 12.5

14. A solution is prepared by dissolving 38.6 g sucrose ($C_{12}H_{22}O_{11}$) in 495 g of water. Determine the mole fraction of sucrose if the final volume of the solution is 508 mL.
A) 4.09×10^{-3}
B) 7.80×10^{-2}
C) 1.28×10^{-3}
D) 7.23×10^{-2}
E) 2.45×10^{-3}
Answer: A
Diff: 3 Page Ref: 12.5

15. Determine the vapor pressure of a solution at 25°C that contains 76.6 g of glucose ($C_6H_{12}O_6$) in 250.0 mL of water. The vapor pressure of pure water at 25°C is 23.8 torr.
A) 70.8 torr
B) 72.9 torr
C) 23.1 torr
D) 22.9 torr
E) 7.29 torr
Answer: C

Diff: 3 Page Ref: 12.6

16. Give the reason that antifreeze is added to a car radiator.
A) The freezing point is lowered and the boiling point is elevated.
B) The freezing point is elevated and the boiling point is lowered.
C) The freezing point and the boiling point are elevated.
D) The freezing point and the boiling point are lowered.
E) None of the above.
Answer: A
Diff: 1 Page Ref: 12.6

17. A 150.0 mL sample of an aqueous solution at 25°C contains 15.2 mg of an unknown nonelectrolyte compound. If the solution has an osmotic pressure of 8.44 torr, what is the molar mass of the unknown compound?
A) 223 g/mol
B) 294 g/mol
C) 341 g/mol
D) 448 g/mol
E) 195 g/mol
Answer: A
Diff: 4 Page Ref: 12.6

18. Choose the aqueous solution below with the **lowest** freezing point. These are all solutions of nonvolatile solutes and you should assume ideal van't Hoff factors where applicable.
A) 0.075 *m* NaI
B) 0.075 *m* $(NH_4)_3PO_4$
C) 0.075 *m* $NaBrO_4$
D) 0.075 *m* LiCN
E) 0.075 *m* KNO_2
Answer: B
Diff: 1 Page Ref: 12.7

19. Given the following balanced equation, determine the rate of reaction with respect to [NOCl].

$$2\ NO(g) + Cl_2(g) \rightarrow 2\ NOCl(g)$$

A) Rate $= -\frac{1}{2}\frac{\Delta[NOCl]}{\Delta t}$
B) Rate $= +\frac{1}{2}\frac{\Delta[NOCl]}{\Delta t}$
C) Rate $= -\frac{1}{2}\frac{\Delta[NO]}{\Delta t}$
D) Rate $= -\frac{2}{\Delta t}\frac{\Delta[NOCl]}{\Delta t}$
E) It is not possible to determine without more information.
Answer: B

Diff: 2 Page Ref: 13.2

20. Given the following balanced equation, determine the rate of reaction with respect to [NOCl]. If the rate of Cl_2 loss is 4.84×10^{-2} M/s, what is the rate of formation of NOCl?

$$2\ NO(g) + Cl_2(g) \rightarrow 2\ NOCl(g)$$

A) 4.84×10^{-2} M/s
B) 2.42×10^{-2} M/s
C) 1.45×10^{-1} M/s
D) 9.68×10^{-2} M/s
E) 1.61×10^{-2} M/s
Answer: D
Diff: 3 Page Ref: 13.2

21. What is the overall order of the following reaction, given the rate law?

$$2\ X + 3\ Y \rightarrow 2\ Z \qquad \text{Rate} = k[X]^1[Y]^2$$

A) 3rd order
B) 5th order
C) 2nd order
D) 1st order
E) 0th order
Answer: A
Diff: 2 Page Ref: 13.3

22. Given the following rate law, how does the rate of reaction change if the concentration of Y is doubled?

$$\text{Rate} = k\,[X][Y]^2$$

A) The rate of reaction will increase by a factor of 2.
B) The rate of reaction will increase by a factor of 4.
C) The rate of reaction will increase by a factor of 5.
D) The rate of reaction will decrease by a factor of 2.
E) The rate of reaction will remain unchanged.
Answer: B
Diff: 2 Page Ref: 13.3

23. How many half-lives are required for the concentration of reactant to decrease to 1.56% of its original value?
A) 6
B) 5
C) 7
D) 6.5

E) 7.5
Answer: A
Diff: 1 Page Ref: 13.4

24. The half life for the decay of radium is 1620 years. What is the rate constant for this first-order process?
A) 4.28×10^{-4} yr^{-1}
B) 1.12×10^{-4} yr^{-1}
C) 2.33×10^{-4} yr^{-1}
D) 8.91×10^{-4} yr^{-1}
E) 6.17×10^{-4} yr^{-1}
Answer: A
Diff: 2 Page Ref: 13.4

25. The first-order rearrangement of CH_3NC is measured to have a rate constant of 3.61 x 10^{-15} s^{-1} at 298 K and a rate constant of 8.66×10^{-7} s^{-1} at 425 K. Determine the activation energy for this reaction.
A) 160. kJ/mol
B) 240. kJ/mol
C) 417 kJ/mol
D) 127 kJ/mol
E) 338 kJ/mol
Answer: A
Diff: 3 Page Ref: 13.5

26. Which of the following statements is TRUE?
A) The rate constant does not depend on the activation energy for a reaction where the products are lower in energy than the reactants.
B) A catalyst raises the activation energy of a reaction.
C) Rate constants are temperature dependent.
D) The addition of a homogeneous catalyst does not change the activation energy of a given reaction.
E) None of the above are true.
Answer: C
Diff: 1 Page Ref: 13.7

27. The second-order reaction 2 $Mn(CO)_5 \rightarrow Mn_2(CO)_{10}$, has a rate constant equal to 3.0×10^9 M^{-1} s^{-1} at 25°C. If the initial concentration of $Mn(CO)_5$ is 2.0×10^{-5} M, how long will it take for 90.% of the reactant to disappear?
A) 6.7×10^{-16} s
B) 7.4×10^{-15} s
C) 1.5×10^{-4} s
D) 6.0×10^{3} s
Answer: C
Diff: 3 Page Ref: 13.4

28. Express the equilibrium constant for the following reaction.

$$2\ CH_3Cl(g) + Cl_2(g) \rightleftharpoons 2\ CH_2Cl_2(g) + H_2(g)$$

A) $K = \dfrac{[CH_2Cl_2][H_2]}{[CH_3Cl][Cl_2]}$

B) $K = \dfrac{[CH_2Cl_2]^2[H_2]}{[CH_3Cl]^2[Cl_2]}$

C) $K = \dfrac{[CH_3Cl]^2[Cl_2]}{[CH_2Cl_2]^2[H_2]}$

D) $K = \dfrac{[CH_3Cl][Cl_2]}{[CH_2Cl_2][H_2]}$

E) $K = \dfrac{[CH_3Cl]^{1/2}[Cl_2]}{[CH_2Cl_2]^{1/2}[H_2]}$

Answer: B
Diff: 2 Page Ref: 14.3

29. Express the equilibrium constant for the following reaction.

$$P_4(s) + 5\ O_2(g) \rightleftharpoons P_4O_{10}(s)$$

A) $K = \dfrac{[P_4][O_2]^5}{[P_4O_{10}]}$

B) $K = \dfrac{[P_4O_{10}]}{[P_4][O_2]^5}$

C) $K = [O_2]^{-5}$

D) $K = [O_2]^5$

E) $K = \dfrac{[P_4O_{10}]}{[P_4][O_2]^{1/5}}$

Answer: C
Diff: 2 Page Ref: 14.5

30. Which of the following statements is TRUE?
A) Dynamic equilibrium occurs when the rate of the forward reaction equals the rate of the reverse reaction.

B) The equilibrium constant for the forward reaction is equal to the equilibrium constant for the reverse reaction.
C) A reaction quotient (Q) larger than the equilibrium constant (K) means that the reaction will favor the production of more products.
D) Dynamic equilibrium indicates that the amount of reactants and products are equal.
E) All of the above are true.
Answer: A
Diff: 1 Page Ref: 14.7

31. In a reaction mixture containing reactants and products, each at a concentration of 1M, what is the value of Q?
A) -1
B) 1
C) ∞
D) 0
E) It cannot be determined without concentrations.
Answer: B
Diff: 1 Page Ref: 14.7

32. Consider the following reaction, equilibrium concentrations, and equilibrium constant at a particular temperature. Determine the equilibrium concentration of $SO_2(g)$.

$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$ $K_c = 1.7 \times 10^8$

$[SO_3]_{eq} = 0.0034$ M $[O_2]_{eq} = 0.0018$ M

A) 2.8×10^{13} M
B) 1.88 M
C) 6.1×10^{-6} M
D) 1.0×10^{3} M
E) 1.4 M
Answer: C
Diff: 3 Page Ref: 14.8

33. Identify the change that will always shift the equilibrium to the right.
A) remove reactant
B) increase product
C) remove product
D) increase pressure
E) increase volume
Answer: C
Diff: 2 Page Ref: 14.9

34. Consider the following reaction at equilibrium. What effect will increasing the temperature have on the system?

$Fe_3O_4(s) + CO(g) \rightleftharpoons 3\ FeO(s) + CO_2(g)$ $\Delta H° = +35.9$ kJ

A) The reaction will shift to the left in the direction of reactants.
B) The equilibrium constant will increase.
C) The equilibrium constant will decrease.
D) No effect will be observed.
E) The reaction will shift to the right in the direction of products.
Answer: E
Diff: 2 Page Ref: 14.9

35. Which of the following is an Arrhenius base?
A) CH_3CO_2H
B) NaOH
C) CH_3OH
D) LiCl
E) More than one of these compounds is an Arrhenius base.
Answer: B
Diff: 1 Page Ref: 15.3

36. What is the conjugate acid of HCO_3^- ?
A) H_3O^+
B) H_2O
C) CO_3^{2-}
D) OH^-
E) H_2CO_3
Answer: E
Diff: 1 Page Ref: 15.3

37. Identify the weak diprotic acid.
A) CH_3COOH
B) HCOOH
C) H_3PO_4
D) H_2SO_4
E) H_2CO_3
Answer: E
Diff: 1 Page Ref: 15.3

38. 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) $HBrO_2 < HBrO_3 < HBrO_4 < HBrO$
D) $HBrO_4 < HBrO_2 < HBrO_3 < HBrO$
E) $HBrO < HBrO_4 < HBrO_3 < HBrO_2$
Answer: B
Diff: 1 Page Ref: 15.4

39. Which of the following acids will have the strongest conjugate base?
A) HCl
B) $HClO_4$
C) HNO_3
D) HCN
E) HI
Answer: D
Diff: 1 Page Ref: 15.4

40. What is the K_W of pure water at 50.0°C, if the pH is 6.630?
A) 2.34×10^{-7}
B) 5.50×10^{-14}
C) 2.13×10^{-14}
D) 1.00×10^{-14}
E) There is not enough information to calculate the K_W.
Answer: B
Diff: 2 Page Ref: 15.5

41. Calculate the pH of a solution that contains 3.9×10^{-4} M H_3O^+ at 25°C.
A) 4.59
B) 3.41
C) 10.59
D) 9.41
E) 0.59
Answer: B
Diff: 2 Page Ref: 15.5

42. Calculate the hydroxide ion concentration in an aqueous solution with a pH of 4.33 at 25°C.
A) 2.1×10^{-10} M
B) 9.7×10^{-10} M
C) 4.7×10^{-5} M
D) 3.8×10^{-5} M
E) 6.3×10^{-6} M
Answer: A
Diff: 3 Page Ref: 15.5

43. Determine the K_a of an acid whose 0.294 M solution has a pH of 2.80.
A) 1.2×10^{-5}
B) 8.5×10^{-6}
C) 2.7
D) 4.9×10^{-7}
E) 5.4×10^{-3}
Answer: B
Diff: 4 Page Ref: 15.6

44. Which one of the following will form an acidic solution in water?
A) NH_4Cl
B) NaF
C) LiI
D) KNO_3
E) None of the above solutions will be acidic.
Answer: A
Diff: 1 Page Ref: 15.8

45. Determine the pH of a 0.22 M NaF solution at 25°C. The K_a of HF is 3.5×10^{-5}.
A) 10.20
B) 5.10
C) 8.90
D) 11.44
E) 2.56
Answer: C
Diff: 3 Page Ref: 15.8

46. Which of the following is a Lewis acid?
A) BCl_3
B) CH_4
C) NH_3
D) $CHCl_3$
E) None of the above are Lewis acids.
Answer: A
Diff: 1 Page Ref: 15.11

47. The acid-dissociation constant of hydrocyanic acid (HCN) at 25.0°C is 4.9×10^{-10}. What is the pH of an aqueous solution of 0.080 M sodium cyanide (NaCN)?
A) 11.11
B) 2.89
C) 1.3×10^{-3}

D) 7.8×10^{-12}
E) 3.9×10^{-11}
Answer: A
Diff: 4 Page Ref: 15.7

48. Identify a good buffer.
A) small amounts of both a weak acid and its conjugate base
B) significant amounts of both a strong acid and a strong base
C) small amounts of both a strong acid and a strong base
D) significant amounts of both a weak acid and a strong acid
E) significant amounts of both a weak acid and its conjugate base
Answer: E
Diff: 1 Page Ref: 16.2

49. If the pKa of $HCHO_2$ is 3.74 and the pH of an $HCHO_2/NaCHO_2$ solution is 3.89, 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: A
Diff: 2 Page Ref: 16.2

50. Calculate the pH of a buffer that is 0.040 M HF and 0.020 M LiF. The K_a for HF is 3.5×10^{-4}.
A) 2.06
B) 4.86
C) 3.16
D) 3.46
E) 3.76
Answer: C
Diff: 3 Page Ref: 16.2

51. 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 0.0500 moles of solid NaOH. Assume no volume change upon the addition of base. The K_a for HF is 3.5×10^{-4}.
A) 3.34
B) 3.46
C) 3.57
D) 3.63
E) 2.89
Answer: C
Diff: 5 Page Ref: 16.2

52. When titrating a strong monoprotic acid and KOH at 25°C, the
A) pH will be less than 7 at the equivalence point.
B) pH will be greater than 7 at the equivalence point.
C) titration will require more moles of base than acid to reach the equivalence point.
D) pH will be equal to 7 at the equivalence point.
E) titration will require more moles of acid than base to reach the equivalence point.
Answer: D
Diff: 1 Page Ref: 16.4

53. 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 before the addition of any HNO_3. The K_b of NH_3 is 1.8×10^{-5}.
A) 4.74
B) 9.26
C) 11.13
D) 13.00
E) 12.55
Answer: C
Diff: 3 Page Ref: 16.4

54. Which of the following compounds will have the highest molar solubility in pure water?
A) $PbSO_4$, $K_{sp} = 1.82 \times 10^{-8}$
B) $MgCO_3$, $K_{sp} = 6.82 \times 10^{-6}$
C) AgI, $K_{sp} = 8.51 \times 10^{-17}$
D) PbS, $K_{sp} = 9.04 \times 10^{-29}$
E) FeS, $K_{sp} = 3.72 \times 10^{-19}$
Answer: B
Diff: 1 Page Ref: 16.5

55. Give the expression for the solubility product constant for $Ca_3(PO_4)_2$.
A) $\dfrac{[Ca^{2+}]^3[PO_4^{3-}]^2}{Ca_3(PO_4)_2}$
B) $\dfrac{Ca_3(PO_4)_2}{[Ca^{2+}]^3[PO_4^{3-}]^2}$
C) $\dfrac{[Ca^{2+}]^2[PO_4^{3-}]^3}{Ca_3(PO_4)_2}$
D) $[Ca^{2+}]^2[PO_4^{3-}]^3$
E) $[Ca^{2+}]^3[PO_4^{3-}]^2$
Answer: E

Diff: 2 Page Ref: 16.5

56. A solution containing $AgNO_3$ is mixed with a solution of NaCl to form a solution that is 0.10 M in $AgNO_3$ and 0.075 M in NaCl. What will happen once these solutions are mixed? K_{sp} (AgCl) = 1.77×10^{-10}.
A) Nothing will happen since the molar solubility of AgCl is higher than the solution concentrations.
B) Silver chloride will precipitate out of solution, leaving an unsaturated solution of AgCl.
C) Silver chloride will precipitate out of solution, leaving a saturated AgCl solution.
D) Nothing will happen since NaCl and $AgNO_3$ are both soluble compounds.
E) There is not enough information to say anything about this solution.
Answer: C
Diff: 2 Page Ref: 16.6

57. Calculate the pH of a solution that is 0.210 M in nitrous acid (HNO_2) and 0.290 M in potassium nitrite (KNO_2). The acid dissociation constant of nitrous acid is 4.50×10^{-4}.
A) 3.487
B) 3.210
C) 13.86
D) 10.51
E) 4.562
Answer: A
Diff: 4 Page Ref: 16.2

58. What is the molar solubility of barium fluoride (BaF_2) in water? The solubility-product constant for BaF_2 is 1.7×10^{-6} at 25°C.
A) 6.5×10^{-4}
B) 1.2×10^{-2}
C) 1.8×10^{-3}
D) 7.5×10^{-3}
E) 5.7×10^{-7}
Answer: D
Diff: 4 Page Ref: 16.5

59. Which of the following statements is TRUE?
A) Entropy is not a state function.
B) Endothermic processes decrease the entropy of the surroundings, at constant T and P.
C) Endothermic processes are never spontaneous.
D) Exothermic processes are always spontaneous.
E) None of the above are true.
Answer: B
Diff: 1 Page Ref: 17.4

60. For the following example, identify the following.

$$2\ N_2O\ (g)\ \rightarrow\ 2\ N_2(g) + O_2(g)\ + \text{heat}$$

A) a negative ΔH and a negative ΔS
B) a positive ΔH and a negative ΔS
C) a negative ΔH and a positive ΔS
D) a positive ΔH and a positive ΔS
E) It is not possible to determine without more information.
Answer: C
Diff: 2 Page Ref: 17.5

61. Identify the statement that is FALSE.
A) The entropy of a gas is greater than the entropy of a liquid.
B) Entropy generally increases with increasing molecular complexity.
C) Free atoms have greater entropy than molecules.
D) Entropy increases with dissolution.
E) For noble gasses, entropy increases with size.
Answer: C
Diff: 1 Page Ref: 17.6

62. Use Hess's law to calculate $\Delta G°_{rxn}$ using the following information.

$CO(g) \rightarrow C(s) + 1/2\ O_2(g)$ $\Delta G°_{rxn} = ?$

$CO_2(g) \rightarrow C(s) + O_2(g)$ $\Delta G°_{rxn} = +394.4$ kJ
$CO(g) + 1/2\ O_2(g) \rightarrow CO_2(g)$ $\Delta G°_{rxn} = -257.2$ kJ

A) -60.0 kJ
B) +651.6 kJ
C) -265.8 kJ
D) +137.2 kJ
E) +523.0 kJ
Answer: D
Diff: 3 Page Ref: 17.7

63. Determine the equilibrium constant for the following reaction at 298 K.

$Cl(g) + O_3(g) \rightarrow ClO(g) + O_2(g)$ $\Delta G° = -34.5$ kJ

A) 5.66×10^5
B) 0.986

C) 8.96×10^{-7}
D) 4.98×10^{-4}
E) 1.12×10^{6}
Answer: E
Diff: 3 Page Ref: 17.9

64. What element is being oxidized in the following redox reaction?

$$MnO_4^-(aq) + H_2C_2O_4(aq) \rightarrow Mn^{2+}(aq) + CO_2(g)$$

A) C
B) O
C) Mn
D) H
Answer: A
Diff: 2 Page Ref: 18.2

65. Balance the following redox reaction if it occurs in basic solution. What are the coefficients in front of ClO_2 and H_2O in the balanced reaction?

$$H_2O_2(l) + ClO_2(aq) \rightarrow ClO_2^-(aq) + O_2(g)$$

A) $ClO_2 = 1$, $H_2O = 1$
B) $ClO_2 = 1$, $H_2O = 2$
C) $ClO_2 = 4$, $H_2O = 3$
D) $ClO_2 = 4$, $H_2O = 2$
E) $ClO_2 = 2$, $H_2O = 2$
Answer: E
Diff: 4 Page Ref: 18.2

66. Determine the redox reaction represented by the following cell notation.

Mg(s) ⍰ Mg^{2+}(aq) ⍰ Cu^{2+}(aq) ⍰ Cu(s)

A) $Cu(s) + Mg^{2+}(aq) \rightarrow Mg(s) + Cu^{2+}(aq)$
B) $Mg(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Mg^{2+}(aq)$
C) $2\ Mg(s) + Cu^{2+}(aq) \rightarrow Cu(s) + 2\ Mg^{2+}(aq)$
D) $2\ Cu(s) + Mg^{2+}(aq) \rightarrow Mg(s) + 2\ Cu^{2+}(aq)$
E) $3\ Mg(s) + 2\ Cu^{2+}(aq) \rightarrow 2\ Cu(s) + 3\ Mg^{2+}(aq)$
Answer: B
Diff: 3 Page Ref: 18.3

67. What statement is NOT true about standard electrode potentials?
A) $E°_{cell}$ is positive for spontaneous reactions.

B) Electrons will flow from more negative electrode to more positive electrode.
C) The electrode potential of the standard hydrogen electrode is exactly zero.
D) $E°_{cell}$ is found by subtracting the voltage of the cathode from the voltage of the anode (anode – cathode).
E) The electrode in any half-cell with a greater tendency to undergo reduction is positively charged relative to the standard hydrogen electrode and therefore has a positive E°.
Answer: D
Diff: 1 Page Ref: 18.4

68. How many electrons are transferred in the following reaction? (The reaction is unbalanced.)

$$Mg(s) + Al^{3+}(aq) \rightarrow Al(s) + Mg^{2+}(aq)$$

A) 6
B) 2
C) 3
D) 1
E) 4
Answer: A
Diff: 2 Page Ref: 18.5

69. What mass of silver can be plated onto an object in 33.5 minutes at 8.70 A of current?

$$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$$

A) 19.6 g
B) 0.326 g
C) 9.78 g
D) 3.07 g
E) 0.102 g
Answer: A
Diff: 3 Page Ref: 18.8

70. Given that $E°_{red}$ = -1.66 V for Al^{3+}/ Al at 25°C, find $E°$ and E for the concentration cell expressed using shorthand notation below.
Al(*s*) | $Al^{3+}(1.0 \times 10^{-5}$ M) || $Al^{3+}(0.100$ M) | Al(*s*)
A) $E°$ = 0.00 V and E = +0.24 V
B) $E°$ = 0.00 V and E = +0.079 V
C) $E°$ = -1.66 V and E = -1.42 V
D) $E°$ = -1.66 V and E = -1.54 V
Answer: B
Diff: 3 Page Ref: 18.6