Practise Exam Chapter 4

1. Which one of the following is a nonelectrolyte?
   A) aqueous barium nitrate solution
   B) aqueous calcium chloride solution
   C) aqueous lithium phosphate solution
   D) aqueous methyl alcohol solution
   E) aqueous potassium sulfate solution

2. Which one of the following is an electrolyte?
   A) aqueous maple syrup solution
   B) aqueous calcium chloride solution
   C) aqueous sucrose solution
   D) aqueous acetone solution
   E) aqueous ethyl alcohol solution

3. Given the following set of solutions
   A: aqueous sodium perchlorate
   B: aqueous methyl alcohol
   C: aqueous glucose
   D: aqueous calcium chloride
   E: aqueous nickel sulfate
   Which of these solutions are electrolyte solutions?
   A) A and E, only
   B) C, D and E, only
   C) A and D, only
   D) A, D and E, only
   E) B, D and E, only

4. Which statement below is correctly worded and states a fact?
   A) Ionic acids are strong electrolytes and ionize completely when dissolved in water.
   B) Ionic bases are weak electrolytes and ionize completely when dissolved in water.
   C) Ionic bases are strong electrolytes and ionize completely when dissolved in water.
   D) Ionic salts are strong electrolytes and dissociate completely when dissolved in water.
   E) Ionic salts are weak electrolytes and ionize partially when dissolved in water.
5. Which one of the following compounds produces 4 ions per formula unit by dissociation when dissolved in water?
   A) K₂C₂O₄
   B) Al(NO₃)₃
   C) Hg₂(NO₃)₂
   D) NaBrO₃
   E) Na₂S₂O₃

6. Which one of the following compounds produces 3 ions per formula unit by dissociation when dissolved in water?
   A) Hg₂SO₄
   B) NaClO₂
   C) LiClO₄
   D) KClO
   E) (NH₄)₂SO₄

7. In the reaction, K₂SO₄(aq) + Ba(NO₃)₂(aq) → BaSO₄(s) + 2 KNO₃(aq), which ions are the spectator ions?
   A) Ba²⁺ and SO₄²⁻
   B) Ba²⁺ and K⁺
   C) Ba²⁺ and NO₃⁻
   D) K⁺ and SO₄²⁻
   E) K⁺ and NO₃⁻

8. The equation for the reaction, AgNO₃(aq) + K₂CrO₄(aq) → Ag₂CrO₄(s) + KNO₃(aq), can be written as an ionic equation. In this ionic equation, the spectator ions are
   A) Ag⁺ and K⁺
   B) Ag⁺ and CrO₄²⁻
   C) K⁺ and CrO₄²⁻
   D) K⁺ and NO₃⁻
   E) CrO₄²⁻ and NO₃⁻

9. Which one of the following compounds is insoluble in water?
   A) Na₂CO₃
   B) NH₄NO₃
   C) CaCO₃
   D) CaCl₂
   E) LiClO₄
10. Which one of the following compounds is soluble in water?
   A) PbCO₃
   B) AgBr
   C) CaCO₃
   D) MgCl₂
   E) BaSO₄

11. Which set of compounds below is a set in which all members are considered soluble in water?
   A) BaCO₃, NaBrO₃, Ca(OH)₂, and PbCl₂
   B) NaCl, BaCl₂, NH₄NO₃, and LiClO₄
   C) NiCO₃, PbSO₄, AgCl, and Mg(OH)₂
   D) NaCl, AgBr, Na₂CO₃, and Hg₂(NO₃)₂
   E) PbCl₂, Pb(NO₃)₂, AgClO₄, and HgCl₂

12. Which one of the equations below represents what occurs when HC₂H₂O₂ is dissolved in some water?
   A) HC₂H₂O₂ + H₂O → H₂O⁺(aq) + C₂H₂O₂⁻(aq)
   B) HC₂H₂O₂ + H₂O ⇌ H₂O⁺(aq) + C₂H₂O₂⁻(aq)
   C) HC₂H₂O₂ + H₂O ⇌ C₂H₂O₂⁺(aq) + OH⁻(aq)
   D) HC₂H₂O₂ + H₂O ⇌ H₂O⁺(aq) + C₂H₂O₂⁺(aq)
   E) HC₂H₂O₂ + H₂O ⇌ 2 H⁺(aq) + OH⁻(aq) + C₂H₂O₂⁻(aq)

13. Which one of the following is the acid anhydride for the acid, HClO₄?
   A) ClO
   B) ClO₂
   C) ClO₃
   D) ClO₄
   E) Cl₂O₇

14. Which one of the following species is a weak electrolyte?
   A) HClO₄(aq)
   B) HCl(aq)
   C) NaOH(aq)
   D) NH₃(aq)
   E) LiOH(aq)
15. Which one of the following acids is NOT a known strong acid?
   A) HBr\(\text{(aq)}\)
   B) HCl\(\text{(aq)}\)
   C) HClO\(_3\)\(\text{(aq)}\)
   D) HF\(\text{(aq)}\)
   E) HI\(\text{(aq)}\)

16. Which one of the following listed solutions is the least acidic (contains the lowest concentration of hydronium ions due to small degree of ionization)?
   A) 1.0 molar HF\(\text{(aq)}\)
   B) 1.0 molar HCl\(\text{(aq)}\)
   C) 1.0 molar HClO\(_3\)\(\text{(aq)}\)
   D) 1.0 molar HBr\(\text{(aq)}\)
   E) 1.0 molar HI\(\text{(aq)}\)

17. Which one of the following choices represents the net reaction which actually takes place in solution when HC\(_2\)H\(_3\)O\(_2\)\(\text{(aq)}\) is added to Ba(OH)\(_2\)\(\text{(aq)}\)?
   A) HC\(_2\)H\(_3\)O\(_2\)\(\text{(aq)}\) + Ba(OH)\(_2\)\(\text{(aq)}\) \rightarrow Ba(C\(_2\)H\(_3\)O\(_2\))\(_2\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   B) H\(^+\)\(\text{(aq)}\) + OH\(^-\)\(\text{(aq)}\) \rightarrow H\(_2\)O\(\text{(l)}\)
   C) HC\(_2\)H\(_3\)O\(_2\)\(\text{(aq)}\) + OH\(^-\)\(\text{(aq)}\) \rightarrow C\(_2\)H\(_3\)O\(_2\)\(^-\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   D) H\(^+\)\(\text{(aq)}\) + Ba(OH)\(_2\)\(\text{(aq)}\) \rightarrow Ba\(^{2+}\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   E) HC\(_2\)H\(_3\)O\(_2\)\(\text{(aq)}\) + Ba\(^{2+}\)\(\text{(aq)}\) \rightarrow Ba(C\(_2\)H\(_3\)O\(_2\))\(_2\)\(\text{(aq)}\) + H\(^+\)\(\text{(aq)}\)

18. Which one of the following choices represents the net reaction which actually takes place in solution when HNO\(_3\)\(\text{(aq)}\) is added to Mg(OH)\(_2\)\(\text{(s)}\)?
   A) HNO\(_3\)\(\text{(aq)}\) + Mg(OH)\(_2\)\(\text{(s)}\) \rightarrow Mg(NO\(_3\))\(_2\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   B) H\(^+\)\(\text{(aq)}\) + OH\(^-\)\(\text{(aq)}\) \rightarrow H\(_2\)O\(\text{(l)}\)
   C) HNO\(_3\)\(\text{(aq)}\) + OH\(^-\)\(\text{(s)}\) \rightarrow NO\(_3\)\(^-\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   D) H\(^+\)\(\text{(aq)}\) + Mg(OH)\(_2\)\(\text{(s)}\) \rightarrow Mg\(^{2+}\)\(\text{(aq)}\) + H\(_2\)O\(\text{(l)}\)
   E) HNO\(_3\)\(\text{(aq)}\) + Mg\(^{2+}\)\(\text{(aq)}\) \rightarrow Mg(NO\(_3\))\(_2\)\(\text{(aq)}\) + H\(^+\)\(\text{(aq)}\)

19. 66.7 mL of 18.0 molar sulfuric acid solution was dissolved in enough water to make 500 mL of solution. The molarity of the diluted mixture is
   A) 2.40 molar
   B) 0.135 molar
   C) 36.0 molar
   D) 9.00 molar
   E) 0.00741 molar
20. Potassium nitrate, KNO\textsubscript{3}, has a formula weight of 101.10. What is the molar concentration of a solution prepared by dissolving 7.58 grams of potassium nitrate in enough water to prepare 250 mL of the solution?
   A) 0.0937 molar
   B) 0.300 molar
   C) 1.895 molar
   D) 3.065 molar
   E) 3.34 molar

21. A 2.710 g sample contains some CaCl\textsubscript{2}, which is inert to HCl\textit{(aq)} and also some CaO, which reacts: \textit{CaO(s) + HCl(aq) \rightarrow CaCl\textsubscript{2}(aq) + H\textsubscript{2}O(l)}. It took 32.05 mL of 2.445 molar HCl\textit{(aq)} to react completely with all the CaO in the sample. The percent, by weight, of CaO in the sample is
   A) 35.15 %
   B) 61.67 %
   C) 77.62 %
   D) 81.08 %
   E) 84.17 %

22. An ore containing lead carbonate, PbCO\textsubscript{3}, was analyzed. All the lead in a 1.836 gram sample was converted to PbSO\textsubscript{4}(s) using a standard procedure involving treatment with HNO\textsubscript{3}\textit{(aq)} followed by treatment with Na\textsubscript{2}SO\textsubscript{4} solution. The lead sulfate which was recovered weighed 333 mg. What is the percent, by weight, of lead in the ore?
   A) 1.99 %
   B) 12.4 %
   C) 16.0 %
   D) 18.1 %
   E) 20.6 %

23. How many ions per formula unit are produced in solution by dissociation when Hg\textsubscript{2}SO\textsubscript{4} dissolves in water? ______

24. Oxidation is defined as
   A) gain of a proton
   B) loss of a proton
   C) gain of an electron
   D) loss of an electron
   E) capture of an electron by a neutron
25. What is the oxidation number of each oxygen atom in the compound, BaO?  
   A) -1  
   B) -2  
   C) +1  
   D) +2  
   E) +3

26. What is the oxidation number of each carbon atom in the compound, K₂C₂O₄?  
   A) 0  
   B) -4  
   C) +3  
   D) +4  
   E) +6

27. What is the oxidation number of the vanadium atom in the compound, (NH₄)₃VO₄?  
   A) +2  
   B) +3  
   C) +5  
   D) +6  
   E) +7

28. What is the oxidation number of the arsenic atom in the AsO₄³⁻ ion?  
   A) +1  
   B) +3  
   C) +4  
   D) +5  
   E) +6

29. Which one of the following processes represents an oxidation?  
   A) Ba²⁺(aq) + CrO₄²⁻(aq) → BaCrO₄(s)  
   B) 2 H⁺(aq) + CO₃²⁻(aq) → H₂O(l) + CO₂(g)  
   C) Fe³⁺(aq) → Fe²⁺(aq)  
   D) MnO₂(s) → MnO₄⁻(aq)  
   E) 2 CrO₄²⁻(aq) + 2 H⁺(aq) → Cr₂O₇²⁻(aq) + H₂O(l)
30. Which one of the following processes represents a reduction?
   A) \( \text{Ba}^{2+}(aq) + \text{CrO}_4^{2-}(aq) \rightarrow \text{BaCrO}_4(s) \)
   B) \( 2 \text{H}^+(aq) + \text{CO}_3^{2-}(aq) \rightarrow \text{H}_2\text{O}(l) + \text{CO}_2(g) \)
   C) \( \text{CrO}_4^{2-}(aq) \rightarrow \text{Cr}^{3+}(aq) \)
   D) \( \text{MnO}_2(s) \rightarrow \text{MnO}_4^{-}(aq) \)
   E) \( 2 \text{CrO}_4^{2-}(aq) + 2 \text{H}^+(aq) \rightarrow \text{Cr}_2\text{O}_7^{2-}(aq) + \text{H}_2\text{O}(l) \)

31. What is the change in oxidation of each chromium atom in the process,
   \( \text{K}_2\text{CrO}_4 \rightarrow \text{Cr}_2(\text{SO}_4)_3 \)
   A) -1
   B) -6
   C) +3
   D) -3
   E) +6

32. What is the change in oxidation of each manganese atom in the process,
   \( \text{KMnO}_4 \rightarrow \text{MnSO}_4 \)
   A) +3
   B) -3
   C) -6
   D) -5
   E) +1

33. What is the change in oxidation of each iodine atom in the process,
   \( \text{KI} \rightarrow \text{KIO}_3 \)
   A) +3
   B) -1
   C) +6
   D) -6
   E) +4

34. Balance the half reaction, \( \text{H}_2\text{S}(aq) \rightarrow \text{S}(s) \), taking place in acidic media. Which answer below describes how many electrons are needed to balance the half reaction?
   A) 2 electrons, left side
   B) 2 electrons, right side
   C) 4 electrons, left side
   D) 4 electrons, right side
   E) 8 electrons, right side
35. Balance the half reaction, \( \text{C}_5\text{O}_5^{2-}(\text{g}) \rightarrow \text{CO}_3^{2-}(\text{aq}) \), taking place in basic media. Which answer below describes how many hydroxide ions are needed to balance the half reaction?
A) 8 ions, left side
B) 12 ions, right side
C) 12 ions, left side
D) 20 ions, left side
E) 20 ions, right side

36. Balance the half reaction, \( \text{C}_8\text{H}_{10}(l) \rightarrow \text{C}_8\text{H}_4\text{O}_4^{2-}(\text{aq}) \), taking place in basic media. Which answer below describes how many electrons are needed to balance the half reaction?
A) 4 electrons, left side
B) 8 electrons, right side
C) 8 electrons, left side
D) 12 electrons, left side
E) 12 electrons, right side

37. When you balance the redox equation,
\[ \text{C}_4\text{H}_{10}(l) + \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{H}_6\text{C}_4\text{O}_4(s) + \text{Cr}^{3+}(\text{aq}) + \text{H}_2\text{O}(l) \]
the oxidizing agent is
A) \( \text{C}_4\text{H}_{10}(l) \)
B) \( \text{Cr}_2\text{O}_7^{2-}(\text{aq}) \)
C) \( \text{H}^+(\text{aq}) \)
D) \( \text{H}_6\text{C}_4\text{O}_4(s) \)
E) \( \text{Cr}^{3+}(\text{aq}) \)

38. When the balancing of the equation for the reaction,
\[ \text{C}_8\text{H}_{10}(l) + \text{NtO}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{C}_8\text{H}_4\text{O}_4^{2-}(\text{aq}) + \text{Nt}^{2+}(\text{aq}) + \text{H}_2\text{O}(l) \]
taking place in acidic media is completed, what is the sum of ALL the coefficients in the equation?
A) 12
B) 20
C) 24
D) 26
E) 32
39. When the balancing of the equation for the reaction, 
\[ \text{HSO}_3^{-}(aq) + \text{MnO}_4^{-}(aq) \rightarrow \text{MnO}_2(s) + \text{HSO}_4^{-}(aq) \] 
Taking place in slightly acidic media is properly completed, what is the sum of ALL the coefficients in the equation?
A) 7
B) 9
C) 13
D) 15
E) 19

40. When the balancing of the equation for the reaction, 
\[ \text{CrO}_4^{2-}(aq) + \text{Br}^{-}(aq) \rightarrow \text{CrO}_2(aq) + \text{BrO}_3(aq) \] 
Taking place in basic solution media is properly completed, what is the sum of ALL the coefficients in the equation?
A) 6
B) 8
C) 9
D) 10
E) 14

41. In terms of activity, the series in increasing order for metals is found to be, 
Au < Ag < Cu < Sn < Cd < Zn < Al < Mg < Na < Cs
Which reaction below **occurs spontaneously** upon mixing the reagents shown?
A) Sn(s) + Zn\(^{2+}\)(aq) \rightarrow \text{Sn}^{2+}(aq) + \text{Zn}(s)
B) Ag(s) + Mg\(^{2+}\)(aq) \rightarrow \text{Ag}^{+}(aq) + \text{Mg}(s)
C) Zn(s) + Au\(^{3+}\)(aq) \rightarrow \text{Zn}^{2+}(aq) + \text{Au}(s)
D) Ag(s) + Mn\(^{2+}\)(aq) \rightarrow \text{Ag}^{+}(aq) + \text{Mn}(s)
E) Sn(s) + Al\(^{3+}\)(aq) \rightarrow \text{Sn}^{2+}(aq) + \text{Al}(s)

42. In terms of activity, the series in increasing order for metals is found to be, 
Au < Ag < Cu < Sn < Cd < Zn < Al < Mg < Na < Cs
Based on this list, which one of the elements presented below would undergo oxidation least readily?
A) Mg
B) Al
C) Cu
D) Cd
E) Zn
43. When the hydrocarbon, \( \text{C}_8\text{H}_{16} \), undergoes complete combustion, which is an oxidation-reduction reaction, a specific set of products are formed. If you write the equation for the reaction and balance it, the sum of the coefficients for the reagents in the balanced equation will be
A) 17
B) 19
C) 21
D) 26
E) 29

44. When the carbohydrate, \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \), undergoes complete combustion, which is an oxidation-reduction reaction, a specific set of products are formed. If you write the equation for the reaction and balance it, the sum of the coefficients for the reagents in the balanced equation will be
A) 24
B) 35
C) 36
D) 47
E) 83

45. Is the process, \( \text{Cr}_2\text{O}_7^{2-}(aq) \rightarrow \text{Cr}^{3+}(aq) \) an oxidation or a reduction? 

46. When the equation, \( \text{Zn}(s) + \text{NO}_3^-(aq) \rightarrow \text{NH}_4^+(aq) + \text{Zn}^{2+}(aq) \) is balanced, the \( \text{Zn}/\text{NO}_3^- \) ratio is 

47. The reaction, \( \text{AgNO}_3(aq) + \text{NH}_4\text{Br}(aq) \rightarrow \text{AgBr}(s) + \text{NH}_4\text{NO}_3(aq) \), involves changes in oxidation number and is therefore classified as a redox reaction. __
A) True
B) False

48. What is the oxidation number of each sulfur atom in the compound, \( \text{Rb}_2\text{S}_2\text{O}_4 \)?
A) -2
B) +1
C) +3
D) +5
E) +6
49. What is the oxidation number of the chlorine atom in the HClO₄ molecule?
   A) -1
   B) +3
   C) +5
   D) +7
   E) +9

50. Balance the half reaction, C₅O₅²⁻(g) → CO₃²⁻(aq), taking place in basic media. Which answer below describes how many electrons are needed to balance the half reaction?
   A) 4 electrons, left side
   B) 8 electrons, right side
   C) 8 electrons, left side
   D) 12 electrons, left side
   E) 12 electrons, right side
Answer Key

1. D
2. B
3. D
4. D
5. B
6. E
7. E
8. D
9. C
10. D
11. B
12. B
13. E
14. D
15. D
16. A
17. C
18. D
19. A
20. B
21. D
22. B
23. 2
24. D
25. A
26. C
27. C
28. D
29. D
30. C
31. D
32. D
33. C
34. B
35. D
36. E
37. B
38. D
39. C
40. C
41. C
42. C
43. E
44. C
45. reduction
46. 4:1
47. B
48. C
49. D
50. E