Ch 4 Practice Problems

1. A 12.0-g sample of HF is dissolved in water to give 3.1×10^2 mL of solution. The concentration of the solution is
   A) 3.9 *M*
   B) 3.7 *M*
   C) 0.19 *M*
   D) 1.9 *M*
   E) 0.60 *M*

2. The concentration of a 293.0-mL sample of a calcium chloride solution is 0.422 *M*. What is the mass of the solute?
   A) 9.34 g
   B) 13.72 g
   C) 160 g
   D) 46.8 g
   E) 2.64 g

3. What volume of 2.0 *M* HCl can be prepared from 2.00 L of 9.00 *M* HCl?
   A) 444 mL
   B) 2.25 L
   C) 4.50 L
   D) 9.00 L
   E) none of these

4. How much water must be added to 20.0 mL of a 9.50 *M* sulfuric acid solution to make a 0.480 *M* solution? (Assume volumes are additive.)
   A) 81.0 mL
   B) 101 mL
   C) 376 mL
   D) 396 mL
   E) none of these

5. What volume of 12.0 *M* HCl is required to prepare 16.0 L of 0.250 *M* hydrochloric acid?
   A) 130. mL
   B) 333 mL
   C) 585 mL
   D) 768 mL
   E) none of these

6. To calculate the concentration in molarity of a salt solution, you need to know
   A) the mass of the salt added to the solution and the volume of water added to the solution.
   B) the mass of the salt added to the solution and the total volume of the solution.
   C) the mass of the salt added, the molar mass of the salt, and the total volume of the solution.
   D) the molar mass of the salt and the total volume of the solution.
   E) the mass of the salt added, the molar mass of the salt, the volume of water added, and the total volume of the solution.

7. Which of the following solutions contains the greatest total ion concentration?
   A) One mole of potassium chloride dissolved in 1.0 L of solution.
   B) One mole of iron(II) nitrate dissolved in 1.0 L of solution.
   C) One mole of potassium hydroxide dissolved in 1.0 L of solution.
   D) One mole of sodium phosphate dissolved in 1.0 L of solution.
   E) At least two of these solutions have an equal number of ions, and these contain the greatest total ion concentration.

8. What volume of 0.450 *M* barium nitrate solution is needed to prepare 261.0 mL of a solution that is 0.272 *M* in nitrate?

A) 1.58×10^2 mL
B) 7.89×10^1 mL
C) 3.16×10^2 mL
D) 5.26×10^1 mL
E) 4.32×10^2 mL

9. A 230.-mL sample of a 0.275 *M* solution is left on a hot plate overnight; the following morning the solution is 1.10 *M*. What volume of solvent has evaporated from the 0.275 *M* solution? (Assume volumes are additive.)

A) 58.0 mL
B) 63.3 mL
C) 172 mL
D) 230. mL
E) 288 mL

10. If a student needs to make a 0.10 *M* solution of $NaHCO_3$, how many milliliters of solution can be made using a 0.35-g sample of $NaHCO_3$?

A) 3.5 mL
B) 4.2 mL
C) 35 mL
D) 42 mL
E) 1.0×10^2 mL

11. Consider five solutions that all have the same mass of solute in 100.0 mL of solution. Which has the highest concentration as measured in molarity?

A) KCl
B) NaCl
C) Na_2SO_4
D) NaF
E) $CaCl_2$

12. You dissolve 15.71 g of NH_4NO_3 in 150.0 mL of solution (call this solution A). You take 20.0 mL of solution A and add water until the total volume is 75.0 mL (call this solution B). You take 15.0 mL of solution B and add 25.0 mL of water to it (call this solution C). You mix 10.0 mL of solution B and 10.0 mL of solution C (call this solution D). What is the concentration of ammonium nitrate in solution D?

A) 0.190 *M*
B) 0.279 *M*
C) 0.131 *M*
D) 0.240 *M*
E) none of these

13. Mixing 40.0 mL of a 4.00 *M* sodium chloride solution with 20.0 mL of a 5.00 *M* calcium chloride solution results in a solution with a chloride ion concentration of

A) 4.33 *M*.
B) 4.50 *M*.
C) 6.00 *M*.
D) 7.00 *M*.
E) none of these

14. Consider the reaction between 50.0 mL of 0.200 *M* sodium hydroxide and 75.0 mL of 0.100 *M* HCl. Which of the following statements is correct?

A) After the reaction, the concentration of Na^+ is greater than the concentration of OH^-.
B) The NaOH is the limiting reactant.
C) After the reaction, the concentration of Na^+ is equal to the concentration of Cl^-.
D) After the reaction, the concentration of Na^+ is still 0.200 *M* because Na^+ is a spectator ion.
E) None of these are correct.

15. High concentrations of aqueous solutions of potassium hydroxide and copper(II) nitrate are mixed together. Which statement is correct?
   A) Both KNO_3 and $Cu(OH)_2$ precipitate from solution.
   B) No precipitate forms.
   C) $Cu(OH)_2$ will precipitate from solution.
   D) KNO_3 will precipitate from solution.
   E) No reaction will occur.

16. Which pair of ions would *not* be expected to form a precipitate when dilute solutions of each are mixed?
   A) Cu^{2+}, S^{2-}
   B) Ag^{+}, Cl^{-}
   C) Ca^{2+}, PO_4^{3-}
   D) Mn^{2+}, OH^{-}
   E) Mg^{2+}, SO_4^{2-}

17. An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate, and this reaction produces a solid. What is the formula for the solid?
   A) AgK
   B) $AgCrO_4$
   C) KNO_3
   D) K_2NO_3
   E) Ag_2CrO_4

18. An aqueous solution of barium nitrate reacts with an aqueous solution of sodium sulfate. Identify the solid and indicate its coefficient in the balanced equation.
   A) $NaNO_3$, 1
   B) $BaSO_4$, 1
   C) $NaNO_3$, 2
   D) $BaSO_2$, 2
   E) none of these

19. Lead(II) nitrate reacts with sodium chloride in aqueous solution to form a precipitate. What is the net ionic equation for this reaction?
   A) $Pb^{2+}(aq) + 2NO_3^{-}(aq) \rightarrow Pb(NO_3)_2(s)$
   B) $Na^{+}(aq) + Cl^{-}(aq) \rightarrow NaCl(s)$
   C) $Pb^{2+}(aq) + 2Cl^{-}(aq) \rightarrow PbCl_2(s)$
   D) $Na^{+}(aq) + NO_3^{-}(aq) \rightarrow NaNO_3(s)$
   E) $Na^{+}(aq) + Cl^{2-}(aq) \rightarrow Na_2Cl(s)$

20. When aqueous sodium hydroxide is added to aqueous nitric acid, what is the balanced molecular equation for the reaction that takes place?
   A) $2NaOH(aq) + H_2NO_3(aq) \rightarrow Na_2NO_3(aq) + 2H_2O(l)$
   B) $Na(OH)_2(aq) + H_2NO_3(aq) \rightarrow Na_2NO_3(aq) + 2H_2O(l)$
   C) $NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_2O(l)$
   D) $NaOH(aq) + HNO_4(aq) \rightarrow NaNO_4(aq) + H_2O(l)$
   E) $NaOH(aq) + HNO_2(aq) \rightarrow NaNO_2(aq) + H_2O(l)$

21. What is the net ionic equation for the reaction of aqueous sodium hydroxide with aqueous nitric acid?
   A) $Na^{+}(aq) + OH^{-}(aq) + H^{+}(aq) + NO_3^{-}(aq) \rightarrow Na^{+}(aq) + NO_3^{-}(aq) + H_2O(l)$
   B) $Na^{+}(aq) + OH^{-}(aq) + H^{+}(aq) + NO_3^{-}(aq) \rightarrow NaOH(s) + HNO_3(l)$
   C) $H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$
   D) $Na^{+}(aq) + OH^{-}(aq) \rightarrow NaOH(s)$
   E) none of these

22. Which one of the following basic solutions will *not* neutralize 25.0 mL of a 1.0 *M* sulfuric acid solution?
    A) 25.0 mL of 1.0 *M* NaOH
    B) 25.0 mL of 2.0 *M* KOH
    C) 50.0 mL of 1.0 *M* NaOH
    D) 100.0 mL of 0.50 *M* NaOH
    E) All of these *will* neutralize 25.0 mL of a 1.0 *M* sulfuric acid solution.

23. A 4.000-g sample of the metal nitrate $M(NO_3)_2$ was dissolved in water and treated with excess aqueous sodium sulfate. The sulfate salt that formed weighed 3.318 g. Determine the identity of the metal.
    A) Pb
    B) Ba
    C) Ca
    D) K
    E) none of these

24. Reacting 47.4 mL of 0.320 *M* $AgNO_3$ with 48.0 mL of 0.300 *M* K_2CrO_4 results in what mass of solid formed?
    A) 4.78 g
    B) 2.52 g
    C) 3.40 g
    D) 3.22 g
    E) 1.46 g

25. You mix 50.0 mL of 2.00 *M* lead(II) nitrate with 50.0 mL of 2.00 *M* sodium chloride. What mass of lead(II) chloride should you form?
    A) 12.1 g
    B) 13.9 g
    C) 24.3 g
    D) 27.8 g
    E) none of these

26. What volume of 0.25 *M* HNO_3 is necessary to react exactly with 7.4 g of $Ca(OH)_2$?
    A) 2.0×10^2 mL
    B) 2.5×10^2 mL
    C) 4.0×10^2 mL
    D) 8.0×10^2 mL
    E) 1.2×10^2 mL

27. When aqueous solutions of silver nitrate and potassium chromate are mixed, the blood-red precipitate silver chromate is formed. If 10.0 mL of 0.25 *M* aqueous silver nitrate is mixed with 15.0 mL of 0.14 *M* aqueous potassium chromate, what is the total concentration of ions in the solution after the precipitate is formed?
    A) 0.14 *M*
    B) 0.25 *M*
    C) 0.30 *M*
    D) 0.39 *M*
    E) 0.50 *M*

28. You have separate aqueous solutions of NaOH and $Ca(OH)_2$ with the same concentrations. You wish to neutralize an aqueous solution of HCl. Which basic solution would require more volume to neutralize the acid?
    A) the NaOH solution
    B) the $Ca(OH)_2$ solution
    C) You need to know the concentrations of the basic solutions to answer this question.
    D) You need to know the volume and concentration of the HCl solution to answer this question.
    E) You need to know the concentrations of the acid and bases and the volume of the acid to answer this question.

29. A 0.350-g sample of an acid, HX, requires 25.4 mL of a 0.140 *M* NaOH solution for complete reaction. Calculate the molar mass of the acid.
A) 42.3 g/mol
B) 68.4 g/mol
C) 98.4 g/mol
D) 121.3 g/mol
E) none of these

30. A student weighs out 0.568 g of KHP (molar mass = 204 g/mol) and titrates to the equivalence point with 36.78 mL of a stock NaOH solution. What is the concentration of the stock NaOH solution? KHP is an acid with one acidic proton.
A) 0.100 *M*
B) 3.15 *M*
C) 0.943 *M*
D) 0.0757 *M*
E) none of these

31. What volume of 0.350 *M* KOH is required to react completely with 24.0 mL of 0.650 *M* H_3PO_4?
A) 26.0 mL
B) 52.0 mL
C) 104 mL
D) 156 mL
E) none of these

32. Which of the following statements is(are) true?
Oxidation and reduction

I. cannot occur independently of each other.

II. accompany all chemical changes.

III. describe the loss and gain of electron(s), respectively.

IV. result in a change in the oxidation states of the species involved.

A) I only
B) II only
C) III only
D) IV only
E) I, III, and IV

33. In the reaction $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$, which element, if any, is oxidized?
A) zinc
B) hydrogen
C) sulfur
D) oxygen
E) none of these

34. What is the oxidation state of iodine in IO_3^-?
A) 0
B) +3
C) –3
D) +5
E) –5

35. What is the oxidation state of chromium in K_2CrO_4?

A) +2
B) +4
C) +6
D) -3
E) -4

36. In which state of the following compounds does nitrogen have the most positive oxidation state?

A) HNO_3
B) NH_4Cl
C) N_2O
D) NO_2
E) $NaNO_2$

37. Which of the following reactions does *not* involve oxidation-reduction?

A) $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
B) $Mg + 2HCl \rightarrow MgCl_2 + H_2$
C) $2Na + 2H_2O \rightarrow 2NaOH + H_2$
D) $MnO_2 + 4HCl \rightarrow Cl_2 + 2H_2O + MnCl_2$
E) .NaOH + HBr $\rightarrow H_2O$ + NaBr

38. Which of the following is(are) oxidation-reduction reactions?

I. $PCl_3 + Cl_2 \rightarrow PCl_5$

II. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

III. $CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$

IV. $FeCl_2 + 2NaOH \rightarrow Fe(OH)_2 + 2NaCl$

A) III only
B) IV only
C) I and II only
D) I, II, and III only
E) I, II, III, and IV

39. In the following reaction, which species is the reducing agent?

$$3Cu + 6H^+ + 2HNO_3 \rightarrow 3Cu^{2+} + 2NO + 4H_2O$$

A) H^+
B) Cu
C) N in NO
D) Cu^{2+}
E) N in HNO_3

40. In the reaction $Mg(s) + Pb(NO_3)_2(aq) \rightarrow Mg(NO_3)_2(aq) + Pb(s)$, identify the oxidizing agent.

A) Mg
B) $Pb(NO_3)_2$
C) $Mg(NO_3)_2$
D) Pb
E) O_3

41. The following unbalanced reaction occurs in basic media:

$$Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$$

The coefficient for water in the balanced equation is _____, and water appears on the _____ side of the equation.

A) 7, left
B) 7, right
C) 14, left
D) 14, right
E) none of these

42. When the following reaction is balanced in acidic solution, what is the coefficient of water?

$$Zn(s) + NO_3^-(aq) \rightarrow Zn^{2+}(aq) + NH_4^+(aq)$$

A) 1
B) 2
C) 3
D) 4
E) none of these

43. The following reaction occurs in aqueous acid solution:

$$NO_3^- + I^- \rightarrow IO_3^- + NO_2$$

In the balanced equation, what is the coefficient of NO_3^-?

A) 2
B) 3
C) 4
D) 5
E) 6

44. When the equation $Cl_2 \rightarrow Cl^- + ClO_3^-$ (basic solution) is balanced using the smallest whole-number coefficients, what is the coefficient of OH^-?

A) 1
B) 2
C) 3
D) 4
E) 6

Answers:

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