Review for Unit 9: Solutions

Practice Multiple Choice Questions:

1. Which of the following substances is/are pure substances?
   a) N_2 (g)
   b) NaCl (s)
   c) CH_3COOH (l)
   d) all of the above

2. A glass of clear iced tea is classified as a(n):
   a) element
   b) compound
   c) solution
   d) mechanical mixture

3. Which of the following would a chemist classify as a pure substance(s)?
   a) a glass of pure Florida orange juice
   b) a glass of pure Ontario apple juice
   c) a glass of pure distilled water
   d) all of the above

4. Which of the following are characteristics of ALL solutions?
   I)   they are transparent
   II)   they are permanent
   III)   they are homogeneous
   IV)   they are pure substances

   a) I, II and III only
   b) I, III and IV only
   c) II and III only
   d) I, II, III and IV

5. The components of a solution can be separated by:
   a) distillation
   b) filtration
   c) combustion
   d) all of the above

6. Rose metal is an alloy of 50.0 % bismuth, 27.1% lead and 22.9% tin. Which of the following statements is/are true about Rose metal?
   a) lead is the solvent and tin is a solute
   b) tin is the solvent and bismuth is a solute
   c) bismuth is the solvent and tin is a solute
   d) bismuth, lead and tin are all solutes

7. Aqueous solutions:
   a) have water as the solvent
   b) are always transparent
   c) have only one phase
   d) all of the above

8. Which of the following has a variable composition?
   a) liquid bromine
   b) liquid acetone (C_3H_6O)
   c) a solution of nitric acid
   d) all of the above have variable composition

9. Which of the following statements is/are true?
   a) as the temperature of the solution increases, the solubility of gases usually decreases
   b) solutions are heterogeneous
   c) solutions are pure substances
   d) all of the above

10. Clean, dry air contains approximately 78% nitrogen, 21% oxygen and 1% trace gases. Which of the following statements is/are true?
    a) air is a pure substance
    b) nitrogen is a solvent
    c) air is heterogeneous
    d) all of the above

11. Which of the following is an example of a homogeneous mixture?
    a) chocolate chips in chocolate chip cookies
    b) sand sitting at the bottom of a glass of water
    c) raisins in Raisin Bran cereal
    d) vinegar that has been diluted with water

Refer to the solubility graph to answer questions 12 – 25.
Do not worry about significant digits for these questions.

12. A solution contains 80 g of $NaNO_3$ in 100 mL of water at
    40ºC. The solution is:
    a) saturated   c) super-saturated
    b) unsaturated

13. What is the solubility of NH_3 at 90ºC?
    a) 90 g/100 mL   c) 68 g/100 mL
    b) 10 g/100 mL   d) 42g/100 mL

14. How many grams of KNO_3 will dissolve in 200 mL of water
    at 70ºC ?
    a) 130 g   c) 65 g
    b) 260 g   d) 80 g

15. How many grams of KNO_3 will dissolve in 50 mL of water
    at 60ºC ?
    a) 204 g   c) 51 g
    b) 102 g   d) 40 g

16. How many grams of KCl can dissolve in 40 mL of water at 50ºC?
    a) 50 g   c) 10 g
    b) 40 g   d) 16 g

17. What is the minimum temperature required to dissolve 60 g of NH_4Cl in 100 mL of water?
    a) 55ºC   b) 40ºC   c) 70ºC   d) 78ºC

18. What is the minimum temperature required to dissolve 40 g of NH_4Cl in 125 mL of water?
    a) 32ºC   b) 70ºC   c) 10ºC   d) 50ºC

19. What is the minimum temperature required to dissolve 52.5 g of NH_4Cl in 75 mL of water?
    a) 55ºC   b) 90ºC   c) 100ºC   d) 39ºC

20. Which solute is likely a gas at SATP?
    a) KI   b) NH_3 c) $NaNO_3$ d) NH_4Cl

21. Which solute has the lowest solubility at 50ºC ?
    a) NH_3 b) NaCl   c) $KClO_3$ d) KCl

22. A solution contains 35 g of NH_4Cl per 100 mL of water at 70ºC. How much more NH_4Cl can be dissolved in
    this solution?
    a) 25 g more   b) 55 g more   c) 60 g more   d) no more

23. At what temperature are the solubilities of KCl and KNO_3 equal?
    a) 57ºC   b) 28ºC   c) 37ºC   d) 20ºC

24. A solution contains 140 g of sodium nitrate per 100 mL water at 10ºC. A single seed crystal is added.
    Approximately how many grams of sodium nitrate will precipitate out?
    a) 60 g   b) 140 g   c) 80 g   d) 6 g

25. Which solute has the highest solubility at 20ºC ?
    a) NH_3 b) NaCl   c) $NaNO_3$ d) KI

26. A solution contains 130 g of KNO_3 in 100 mL of water. At which temperature is the solution saturated?
    a) 60ºC   b) 70ºC   c) 80ºC   d) 90ºC

27. 30.0 grams of $Fe(NO_3)_3$ are dissolved in enough water to make 800.0 mL of solution. What is the molar concentration of the final solution?
a) 0.124 M   b) 0.155 M   c) 37.5 M   d) 2.93 M

28. 30.0 grams of $Fe(NO_3)_3$ are added to 200.0 mL of water. If the density of pure water is 1.00 g/mL, what is the concentration of the solution in % W/W?
a) 0.150% W/W   b) 15.0% W/W   c) 13.0% W/W   d) 6.67% W/W

29. Radiator fluid is a solution of ethylene glycol (antifreeze) and water. If 4.00 L of ethylene glycol are mixed with 1.00 L of water, what is the % V/V concentration of the water in the mixture?
a) 80.0% V/V   b) 20.0% V/V   c) 25.0% V/V   d) 40.0% V/V

30. A sugar syrup for canning peaches is made by adding 480.0 g of sugar ($C_{12}H_{22}O_{11}$) to 2.66 L of water. What is the %W/W concentration of the final solution? The density of pure water is 1.00 g/mL.
a) 180% W/W   b) 99.4% W/W   c) 64.3% W/W   d) 15.3% W/W

31. Calculate the mass of sodium nitrite in 450 mL of a 1.20 mol/L solution.
a) 0.54 g   b) 37 g   c) 46 g   d) 83 g

32. A chemistry teacher needs 5.0 L of 3.0 mol/L nitric acid solution. She has a stock solution of 15 mol/L nitric acid (HNO_3). What volume of the stock solution does she need?
a) 0.60 L   b) 2.5 L   c) 1.0 L   d) 9.0 L

33. What is the molar concentration of a solution containing 82.6 g sucrose ($C_{12}H_{22}O_{11}$) dissolved in enough water to make 725 mL of solution?
a) 0.333 M   b) 0.472 M   c) 0.241 M   d) 0.114 M

34. What mass of NaCl is contained in 50.0 mL of a 6.00 M solution?
a) 17.5 g   b) 1.17 g   c) 195 g   d) 2.92 g

35. The concentration of stomach acid, HCl, is approximately 0.10 M. What volume of stomach acid contains 0.25 g of HCl?
a) 0.069 L   b) 0.0069 L   c) 0.025 L   d) 2.5 L

36. Suppose that 50.0 mL of a 0.250 M sucrose solution is diluted to 500.0 mL. What is the molar concentration of the final solution?
a) 2.5 M   b) 40. M   c) 4.0 M   d) 0.025 M

37. Rubbing alcohol is a 70% V/V solution of propanol in water. This means that there are:
a) 70 mL of propanol in 100 mL of rubbing alcohol solution
b) 70 g of propanol in 100 mL of rubbing alcohol solution
c) 70 g of propanol in 100 g of rubbing alcohol solution
d) 30 mL of propanol in 100 mL of rubbing alcohol solution

38. What is the molar concentration of a solution made by dissolving 12.0 g of sodium bromide in 40.0 ml of solution?
a) 0.117 M   b) 2.92 M   c) 0.300 M   d) 0.00300 M

39. 125 mL of a 1.35mol/L solution is diluted to 3.25L. What is the molar concentration of the final solution?
a) 0.416 M   b) 0.0519 M   c) 0.400 M   d) 0.0105 M

40. A substance has two phases. It is a(n):
a) element   c) solution
b) compound   d) mechanical mixture

Review for Unit 9: Solutions

1. Be able to use the following terms, and be able to write definitions for the words in **bold**:

Alloy	Heterogeneous	Phase	**Solution**
Aqueous solution	Homogeneous	**Precipitate**	Solvent
Compound	Insoluble	**Saturated solution**	Stock solution
Concentrated	**Mechanical Mixture**	**Solubility**	**Super-saturated solution**
Dilute	Mixture	Soluble	**Unsaturated solution**
Element	**Molar concentration**	Solute	Variable composition

2. Know the characteristics of solutions, how solutions can be separated, and be able to give examples of solid in liquid, gas in liquid, gas in gas, liquid in liquid, solid in solid solutions.

3. As a general rule, what happens to the solubility of solids in water as they are heated?

4. As a general rule, what happens to the solubility of gases in water as they are heated?

5. Be able to describe a test to determine if a solution is saturated, unsaturated or super-saturated. Describe what will happen for each type of solution.

6. Be able to interpret solubility graphs. Refer to the handout: "Practice Questions: Solubility Curves" and answer the following questions:
a) What is the solubility of copper sulfate at 90ºC? _____
b) What temperature is required to dissolve 90.0 g of lead nitrate in 100.0 mL of water? _____
c) What temperature is required to dissolve 120.0 g of copper sulfate in 300.0 mL of water? _____
d) 30.0 g of barium hydroxide is dissolved in 100.0 mL of water at 80ºC. Would the solution be unsaturated, saturated or super-saturated?
e) If the solution from "d" were cooled to 40ºC, would the solution be unsaturated, saturated or super-saturated?
f) If a seed crystal were added to the cooled solution from "e", what would you expect to happen?
g) A super-saturated solution of copper sulfate is prepared by heating 60.0 g of copper sulfate in 100.0 mL of distilled water. The solution is cooled to SATP. If a seed crystal is added, what mass of copper sulfate will crystallize out? _____. What will the concentration of the copper sulfate solution be after the copper sulfate crystals have precipitated out?
h) Do questions 1a and b on page 316 and 317 of your text.

7. Indicate if the following compounds are soluble or insoluble in water:
a) lead (II) bromide _____   f) iron (III) carbonate _____
b) sodium nitrate _____   g) nickel (II) sulfide _____
c) magnesium sulfate _____   h) ammonium hydroxide _____
d) chromium (III) chloride _____   i) calcium sulfide _____
e) barium acetate _____   j) silver iodide _____

8. Write the dissociation reactions for the following ionic compounds as they dissolve in water:

a) KI (s) $\xrightarrow{H_2O}$

b) Na_2S (s) $\xrightarrow{H_2O}$

c) $AlBr_3$ (s) $\xrightarrow{H_2O}$

d) Li_3PO_4 (s) $\xrightarrow{H_2O}$

9. Write word equations and chemical equations for the reactions that occur when the following solutions are mixed. Balance each equation. Indicate the states of the reactants and products that are formed. Refer back to your notes from precipitation reactions in the Chemical Reactions unit if necessary.

a) sodium chloride + silver nitrate →

b) ammonium sulfate + potassium phosphate →

c) lithium carbonate + copper (II) nitrate →

d) zinc sulfate + barium sulfide →

e) mercury (I) chlorate + lead (II) nitrate →

10. A sugar solution ($C_{12}H_{22}O_{11}$) is made by dissolving 100.0 g of sucrose in water. The finished solution has a volume of 225 mL and the density of the final solution is 2.30 g/mL. What is the concentration of the solution:
a) in % W/V
b) in %W/W
c) in molar concentration (molarity)

11. Calculate the mass of solute contained in 750.0 mL of a 0.400M solution of lead (II) acetate.

12. A lab technician is diluting nitric acid. The stock solution is 15.0 M. If the technician needs 450.0 mL of 3.00 M acid, how much of the concentrated nitric acid should the technician measure out?

13. If 250.0 mL of 12.0 M HCl is diluted to a final volume of 1.00 L with water, what is the molarity (molar concentration, M) of the final solution?

14. 50.0 g of K_2CrO_4 are dissolved in enough water to make 500.0 mL of solution. The density of the solution is 1.20 g/mL.
a) What is the molar concentration of this solution?
b) What is the percent by mass of solute in this solution (% W/W)?

15. A chemist needs 2.00 L of 6.00 M KOH. How much KOH should she weigh out?

16. What is the percent composition (% V/V) of clean, dry air?

17. Chapter 6 Review questions, page 309 to 310: Questions 1; 2; 3a,c; 5; 9a,b,c; 11; 12; 17a; 18a