Solutions Practice Items

1. Which of the following is a solution?

A. 14 carat gold
B. milk
C. foggy air
D. cytoplasm

2. The number of gram molecular weights of a solute per liter of solution is called the

A. molality
B. normality
C. formality
D. molarity

3. How many grams of NaOH are required to prepare 250 ml of 2.0 *M* NaOH solution?

A. 5.0 g
B. 10.0 g
C. 17.5 g
D. 20.0 g

4. How much water must be added to 35.0 ml of 0.500 *M* NaOH solution to produce a solution whose concentration is 0.350 *M*?

A. 15.0 ml
B. 25.0 ml
C. 35.0 ml
D. 50.0 ml

5. A solution of silver nitrate is labeled 0.100 *M* $AgNO_3$. How many milliliters of this solution contain 8.50 g $AgNO_3$?

A. 0.1 L
B. 0.5 L
C. 2.0 L
D. 5.0 L

6. A solution is in equilibrium with another phase in which one of the solution components is in the form of a pure substance. Which of the following statements best describes the state of the system?

A. The solute has low solubility in this particular solvent.
B. The solution has precipitated.
C. The solution is saturated.
D. The solution process requires heat flow from the environment.

7. After dissolving ten grams of an unknown substance in 100ml deionized H_2O, the conductivity of the solution increased from 5.5 μS/m to 7.2 S/m. The unknown substance is

A. an acid
B. a base
C. an electrolyte
D. a polar substance

8. Which of the following when dissolved in water would form hydrogen bonds with the water?

A. acetone
B. methanol
C. formaldehyde
D. all of the above

9. 25g of lithium selenite, Li_2SeO_3, can dissolve in 100ml H_20 at 5°C. At 95°C, only 10g will dissolve. From this information we may conclude:

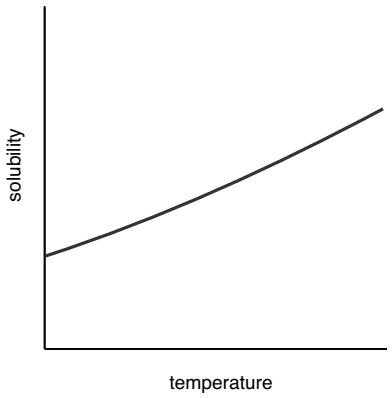
A. lithium selinite is a weak electrolyte.
B. dissolving lithium selinite in water is an exothermic process.
C. lithium selinite is a strong electrolyte.
D. cooling a saturated Li_2SeO_3 solution produces a solution which is super-saturated.

10. That the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid is a statement of:

A. Henry's law
B. Dalton's law
C. Raoult's law
D. Boyle's law

11. Which statement follows from the graph below depicting the relationship between the solubility of substance A in aqueous solution and the temperature.

A. Substance A is an electrolyte.
B. Dissolving substance A at constant temperature causes heat to flow from the environment into the solution.
C. Dissolving substance A is more difficult at higher temperature.
D. Dissolving substance A decreases the boiling point of the solution.



12. A quantity of lithium chloride sufficient to create a saturated solution at ambient temperature is added to water at that temperature and the mixture becomes warm. Which of the following is most likely to occur?

A. The solution is found to have an acidic pH on testing with litmus.
B. The solution is found to have a basic pH on testing with litmus.
C. Hydrogen gas evolves from the solution.
D. Not all the LiCl will dissolve until the solution returns to ambient temperature.

13. The freezing point depression constant K_f of water is 1.86 °C/m. When a 1 molal solution of KBr was tested, the freezing point depression was found to be 3.5°C because

A. In this solution, KBr creates 2 moles of ions per mole of solute dissolved.
B. The van't Hoff factor for KBr at this concentration and temperature is 2.
C. The degree of dissociation is 88%.
D. All of the above

14. Which of the following occurs when 0.5 liter 0.2 M $CaCl_2$ is combined with a 0.5 liter solution saturated with $CaCO_3$ ($K_{sp} = 4.9 \times 10^{-9}$)?

A. no precipitation
B. precipitation of $CaCO_3$
C. formation of supersaturated solution
D. precipitation of $CaCl_2$

15. The K_{sp} of $PbCO_3 = 7.4 \times 10^{-14}$, while the K_{sp} of $PbSO_4$ is 2.0×10^{-8}. If equal volumes of saturated solutions of the two salts were combined,

A. only lead carbonate would precipitate.
B. only lead sulfate would precipitate.
C. both lead sulfate and lead carbonate would precipitate.
D. neither salt would precipitate.

16. After a stream of air was bubbled through a 150g sample of diethyl ether ($C_4H_{10}O$), the mass of the ether was found to have decreased by 10g. Subsequently, 9g of an unknown, nonvolatile substance was then dissolved in 150g of ether and a stream of air was bubbled through the solution under the same conditions as the prior experiment. After the process, the mass of the solution was found to have decreased by 9.5g. What is the approximate molecular weight of the unknown compound?

A. 35 g
B. 60 g
C. 90 g
D. 180 g

17. After addition of excess HBr to a suspension of insoluble $CuCO_3$, the $CuCO_3$ dissolves and

A. the solution turns a bright color.
B. a bluish-grey precipitate forms.
C. a gas evolves.
D. chemiluminescence is observed.

The following passage pertains to questions 18 - 20.

A silver halide compound is one of the compounds formed between silver and one of the halogens — silver bromide (AgBr), chloride (AgCl), iodide (AgI), and three forms of silver fluoride. Although most silver halides involve silver atoms with oxidation states of +1 (Ag^+), silver halides in which the silver atoms have oxidation states of +2 (Ag^{2+}) are known, of which silver(II) fluoride is the only known stable compound.

Silver halides, except for silver fluoride, are only very sparingly soluble in water. Silver nitrate can be used to precipitate halides. This application is useful in quantitative analysis of halides. However, close attention is necessary regarding other compounds in the test solution because some compounds can considerably increase or decrease the solubility of AgX. The solubility product constants of AgCl, AgBr, and AgI are, respectively, 1.7×10^{-10}, 4.1×10^{-13}, and 1.5×10^{-16}.

18. If a solution containing concentrated KBr is stirred with solid AgCl

A. silver will be oxidized.
B. AgCl will dissolve and solid AgBr will precipitate.
C. no reaction will occur.
D. silver will be reduced.

19. 100 ml 0.3 M $AgNO_3$ is combined with 50 ml of a sample taken from a larger volume solution to be tested for Br^-. What is the detection limit for Br^- in the original sample by this method?

A. 2.0×10^{-12} M
B. 6.0×10^{-12} M
C. 1.2×10^{-11} M
D. 1.4×10^{-10} M

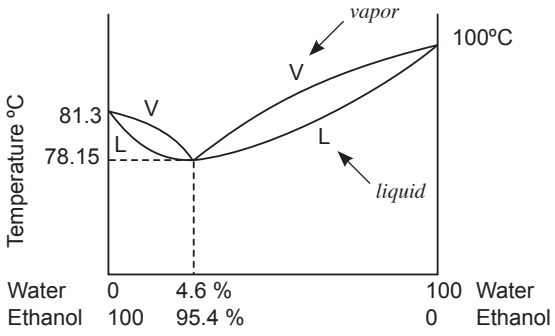
20. Ammonia combines with silver ions to produce a complex ion called the diamminesilver(I) ion, $[Ag(NH_3)_2]^+$. This is a reversible reaction, but the complex is very stable. The addition of ammonia to a solution in contact with silver chloride precipitate will cause

A. silver chloride to dissolve.
B. nitrous oxide gas to be released.
C. ammonium chloride to precipitate.
D. silver chloride to precipitate.

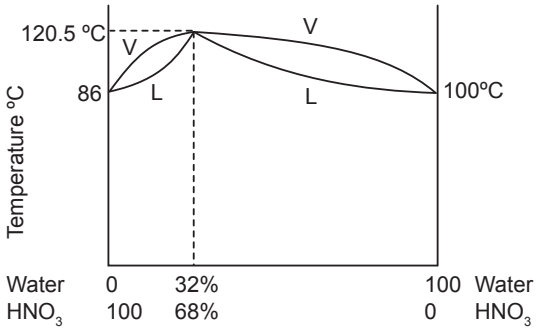
The following passage pertains to questions 21 - 22.

An azeotrope is a mixture of two or more liquids in such a way that its components cannot be altered by simple distillation. This happens because, when an azeotrope is boiled, the vapor has the same proportions of constituents as the unboiled mixture.

There are two types of azeotropes called minimum boiling azeotrope and maximum boiling azeotrope. The solution which show a greater positive deviation from Raoult's law form minimum boiling azeotrope at a specific composition. For example ethanol-water mixture (obtained by fermentation of sugars) on fractional distillation gives a solution containing approximately 95% by volume of ethanol. Once this composition, has been achieved, the liquid and vapor have the same composition, and no further separation occurs. The figure below shows the phase diagram for water-ethanol mixture. The vertical axis is temperature. The horizontal axis is composition.



Solutions that show large negative deviation from Raoult's law form maximum boiling azeotrope at a specific composition. Nitric acid and water is an example of this class of azeotrope. This azeotrope has the approximate composition, 68% nitric acid and 32% water by mass, with a boiling point of 393.5 K. The figure below shows the phase diagram for water-nitric acid mixture.



21. The vapor pressure of an ethanol-water mixture

A. may be greater than the vapor pressure of 100% ethanol.
B. reflects a partial pressure ratio which is the same as the molar ratio in the liquid for all proportions of water and ethanol.
C. attains a minimum value at 95.4% ethanol.
D. is greater than the external pressure except at the azeotropic proportions of water and ethanol.

22. Carrying out the fractional distillation of a 75% nitric acid solution

A. may converge on pure nitric acid.
B. may yield some pure water.
C. will only yield a 68% nitric acid solution.
D. produces a 90% nitric acid solution.