Score _____ / 100 pts.

Name _____
Class _____ Date _____

Solutions make up many of the ordinary substances encountered in everyday life.

The relative amounts of solutes and solvents determine the concentration and the physical properties of a solution. Two important categories of solutions are acids and bases.

STANDARD VI: Students will understand the properties that describe solutions in terms of concentration, solutes, solvents, and the behavior of acids and bases.

1. Define:
   i. Solute – The substance in a solution that dissolves into the solvent.
   ii. Solvent – the substance in a solution into which the solute dissolves.
   iii. Concentrated – A solution with a high solute to solvent ratio.
   iv. Dilute – A solution with a low solute to solvent ratio.
   v. PPM – a measurement of very low concentrations using ratios of parts of solute per million parts of solvent.
   vi. Molarity – a measure of concentration in units of moles of solute per liter of solution.
   vii. Molality – a measure of concentration in units of moles of solute per kilogram of solvent.

Objective 1 Describe factors affecting the process of dissolving and evaluate the effects that changes in concentration have on solutions.

2. Sketch a picture of NaCl (table salt) before and after being dissolved by water. Be sure to show which particles are attracted to each other and where.

The positively charged hydrogen on the water is attracted to the negative chloride ions. The negatively charged oxygen on the water is attracted to the positive sodium ions.

3. List three things that can be done to help a substance dissolve FASTER. Say WHY they help.
   Collisions are required between the salt and the water particles. Increasing temp increases collisions and increases rate. Stirring solution allows for more collisions between water and salt particles and

increases rate. Increasing surface area of the salt crystals leads to more collisions between water and salt particles and increases the rate.

4. If you had 35 mL of a 3.0M HCl solution, how would you calculate the number of moles of HCl present? The capital M indicates moles per liter. So we have 3 moles of HCl in every liter. 35 milliliters is equivalent to 0.035 liters, as a milliliter is one one thousandth of a liter. Multiplying 0.035 liters by 3 moles per liter will provide the number of moles of HCl present, a total of .105 moles of HCl.

5. What is a mole fraction? A mole fraction is a ratio of moles of solvent to total moles found in the solution.

Objective 2 Summarize the quantitative and qualitative effects of colligative properties on a solution when a solute is added.

6. What is a colligative property? A property that is affected by the number of solute particles present in a solution. List three properties that are colligative. Increasing solute particles of a solution will increase the energy required to evaporate the solvent, resulting in a decreased vapor pressure. Decreased vapor pressure leads to an increase in boiling point temperature. Increasing solute particles increases the difficulty with which solvent particles crystalize at the freezing point resulting in a decrease of the freezing point temperature. Increasing solute particle concentration in a solution affects the pressure of solvent particle exchange across a porous barrier, leading to an increase in osmotic pressure.

7. If you increase the concentration of a solution, then the boiling point will _increase_ because _the presence of nonvolatile solute particles increases the difficulty for the solvent particles to escape the solution, decreasing vapor pressure, and increasing boiling point.

   If you increase the concentration of a solution, then the freezing point will _decrease_ because _the presence of solute particles in the solution increases the difficult with which solvent particles can crystalize, requiring a further decrease in temperature before crystallization will occur_.

8. Explain why putting antifreeze in your radiator water in the winter is such a good idea. Antifreeze solutions have solute particles present, making it more difficult for the water to freeze. How does it work? The presence of solute particles hinders the ability of the water to crystalize resulting in a decrease of freezing point temperature.

9. Why don't the oceans freeze in the winter even if it gets below zero? Oceans contain dissolved solute particles of salt and other substances. The freezing point of ocean water is decreased. How does this relate to putting salt on our roads in the winter? Adding salt to the roads in the winter creates salt solutions when water is on the road, making it more difficult for the water to freeze, keeping the road free of ice.

10. What is vapor pressure? Vapor pressure is a measure of the amount of pressure applied by vaporized particles above the surface of a liquid. In order for a liquid to boil, the measure of its vapor pressure must equal the measure of the air pressure present. How is it affected by an increase in solute concentration? Increasing solute concentration makes it difficult for solvent particles to evaporate, which reduces the presence of vaporized solute particles above the liquid, reducing vapor pressure, requiring higher temperatures to equalize vapor pressure with air pressure and increasing the temperature of the boiling point.

11. Design a simple lab that could be used to determine the affect of salt on the boiling temperature of water. Measure the boiling point of 1 liter of pure water. Then run a series of tests where the amount of salt dissolved in the water is carefully controlled and its effect on boiling temperature is carefully measured.

Objective 3 Differentiate between acids and bases in terms of hydrogen ion concentration.

12. Define:
    i. Hydrogen Ion – A hydrogen atom that has lost its electron, a proton. H^+
    ii. Hydroxide Ion – A water molecule that has lost a hydrogen ion, OH^-
    iii. Hydronium Ion – A water molecule that has gained an extra hydrogen ion, H_3O^+

13. How are H_3O^+ and H^+ ions related? H^+ ions present in water are usually attached to a water molecule resulting in H_3O^+ ions. If aqueous, H^+ and H_3O^+ symbols both indicate dissolved hydrogen ions.

14. How are OH^- and H^+ ions related? When combined H^+ ions and OH^- ions form a water molecule. If a water molecule is dissociated into ions H^+ and OH^- result.

15. If a solution has too many hydrogen ions floating around, then it is _acidic_.
    If a solution has perfectly balanced hydrogen ions and hydroxide ions, then it is _neutral_.
    If a solution doesn't have enough hydrogen ions floating around, then it is _basic_.

16. What does "pH" stand for? the negative power of H^+ concentration. Which ions are related to pH? pH is a shorthand measurement for H^+ concentrations. What about "pOH"? pOH is the negative power of OH^- concentrations. How are pH and pOH related? The equilibrium constant value for when water dissociates into H^+ and OH^- ions is 10^{-14}, which has a negative power of 14. The pH and pOH values must sum to equal the equilibrium constant power, 14.

17. Which numbers on the pH scale are acidic? As pH values represent negative powers, smaller numbers of pH indicate increased concentrations. Values between 0 and 7 are acidic. Basic? Values between 7 and 14 are basic. Neutral? When pH equals 7, hydronium and hydroxide concentrations are equal and the solution is neutral. What is the highest number on the pH scale end? The scale spans from 0 to 14.

18. What is a neutralization reaction? Neutralization occurs when hydronium ions react with hydroxide ions to form water. What is a salt? Most acidic solutions, where hydronium is present, include an anion dissolved in the water. Basic solutions, where hydroxide is present, include an additional dissolved cation. When these acidic and basic solutions are mixed, the additional dissolved cations and anions that remain after the water is formed from hydronium and hydroxide is the salt.

19. I put litmus paper into an unknown solution. It turns red. My solution is _acidic_.

20. Name some common acids & bases found in your home. Common acids include citric drinks, carbonated drinks, many toilet or drain cleaners, battery solutions etc. Common bases include many soaps, ammonia, antiacid tablets, etc.

21. What causes acid rain, and why is it so dangerous? Acid rain results when nonmetal oxides, like carbon dioxide, sulfur dioxide or phosphorus trioxide are released into the atmosphere. These nonmetal oxides react with water in the atmosphere resulting in carbonic, sulfuric, and phosphoric acid formation. As precipitation falls, the rain can be quite acidic. Acid rain is dangerous because as

pH levels of water increases it has detrimental effect on many forms of vegetation, sea life, and tends to react with many types of minerals.

22. Describe a titration. A titration is a controlled neutralization reaction used to determine chemical levels of solutions of unknown concentrations. (What chemicals go where and why?) A chemical of known concentration that can neutralize the unknown solution is placed in a burette and dispensed in a controlled fashion into the flask containing the unknown solution. An indicator chemical is added to the unknown chemical to indicate the point at which the chemical is neutralized. What do we use titrations for? Titrations are used to determine the concentrations of solutions.