Big Chem Problem Set

SOLUTIONS, ACIDS & BASES

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1. Water is mixed with sugar, resulting in a transparent, colorless liquid. What evidence will there be that this is a mixture rather than a new compound? Which is the solute, and which is the solvent?

2. Based on Table F indicate which of the following compounds is water soluble and which is insoluble? Li_2CO_3, $Fe(OH)_3$, $CaCrO_4$, BaS, $(NH4)_3PO_4$, $Al(ClO_3)_3$, $PbSO_4$, NaOH, $CuSO_4$, KNO_3

3. According to your reference table:
   (a) What is the compound which is the most soluble at 20°C?
   (b) What is the compound which is the least soluble at 10°C? What is the compound which is the least soluble at 80°C?
   (c) How many grams of potassium nitrate needed to saturate 100 mL of water at 70°C?
   (d) What are the formulas of the compounds that vary inversely with temperature?
   (e) One hundred mL of a sodium nitrate solution is saturated at 10°C. How many additional grams are neede d to saturate the solution at 50°C?
   (f) One hundred mL of a saturate KCl solution at 80°C will precipitate 10 grams of salt when cooled to what temperature?
   (g) What are the two salts that have the same degree of solubility at 70°C?
   (h) What is the salt with a solubility that's least affected by a change in temperature?
   (i) What is the salt that has the greatest increase in solubility in the temperature range between 30°C and 50°C?
   (j) What is the number of grams of sodium nitrate that must be added to 50 mL of water to produce a saturated solution at 50°C?
   (l) At what temperature do saturated solutions of sodium chloride and potassium chloride contain the same mass of solute per 100 mL of water?
   (m) A saturated solution of potassium nitrate is prepared at 60°C using 200 mL of water. If the solution is cooled to 30°C, how many grams w ill precipitate out of the solution?
   (n) How many more grams of ammonia can be dissolved in 100 mL of water at 10°C than at 90°C?
   (o) A saturated solution of sodium nitrate in 100 mL of water at 40°C is heated to 50°C. What is the rate of increase in solubility grams per degree?
   (p) Thirty grams of KCl is dissolved in 100 mL of water at 45°C. What is the number of additional grams of KCl that would be needed to make the solution saturated at 80°C?

4. A warm can of soda is dropped and bounces down a flight of stairs. When it is opened, carbon dioxide gas coming out of solution causes it to spray all over. Explain the affect of each of the following: the fact that the soda was warm, the fact that the can was opened.

5. Sugar is added to a hot cup of coffee and stirred. The sugar dissolves. Explain the affect of each: the fact that the coffee was hot, the fact that the coffee was stirred.

6. Which dissolves faster, a teaspoon of sugar or a sugar cube? Why?

7. The table at the end of this problem set lists four factors that may effect the rate at which solids and gases dissolve. Fill in the table by indicating if the rate of dissolving increases, decreases, or is not effected. Then explain why.

8. Finding concentrations – the density of water is 1 g/mL. What is the concentration of 45 mL of a solution containing 9.0 g of $KClO_3$?

9. A solution is prepared by mixing 20.0 g of $NaNO_3$ with 100. mL of water. What is the percentage mass of the solution?

10. A 250. mL sample of air at STP contains approximately 52.5 mL of $O_{2(g)}$. What is the percentage of oxygen in air?

11. A polar solvent is prepared by mixing 27.5 mL of propanone with 222.5 mL of water. What is the percentage by volume of propanone in the mixture?

12. How many parts per million of sulfur dioxide are there in a solution containing 0.065 g of sulfur dioxide in 5,000 mL of water?

13. If 19 mL of alcohol are dissolved in 31 mL of water, what is the percentage by volume of alcohol?

14. If 0.002 g of $PbCl_2$ are dissolved in 2.0 L of water, how many parts per million are dissolved?

15. If 15 g of KNO_3 are dissolved in 235 g of water, what is the percentage of solute by mass?

16. What is the percentage by mass of a solution prepared with 34g of KI and 126 g of water?

17. What is the concentration of a solution made with 0.056 g of $CO_{2(g)}$ and 200 mL of water?

18. Determine the molarity of 500. mL of a solution with 0.35 mol of dissolved solute.

19. A 200. mL sample of a solution contains 4.0 g of NaOH. What is its molarity?

20. How many grams of KNO_3 are needed to prepare 25 mL of a 2.0 M solution?

21. How many moles of $MgSO_4$ are contained in 50. mL of a 3.0 M solution?

22. How many grams of $CaCl_2$ are dissolved in 80.0 mL of a 0.75 M solution?

23. What is the molarity of 300 mL of a solution that contains 0.60 mol of dissolved ammonia?

24. What is the molarity of 5.0 L of a solution containing 200. g of dissolved $CaCO_3$?

25. How many grams of NaCl are needed to prepare 500. mL of a 0.400 M solution?

26. How many moles of solute are contained in 3.0 L of a 1.5 M solution?

27. What is the molarity of 750 mL of a solution that contains 40.0 g of dissolved $CuSO_4$?

28. Why is salt put on icy roads and sidewalks in the winter?

29. How will the boiling points of pure water and sea water compare? Why?

30. How does adding salt to water affect its boiling point?

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31. Draw a diagram showing the result when one hydrogen (proton) is pulled off one water molecule and attached to another. What are the formulas of the ions formed? Write an equation showing the formation of the ions from two molecules of water: The hydronium ion (H_3O^+) and the hydroxide ion (OH^-) are formed by the reaction between water molecules.

32. Determine if each is an electrolyte: $CaCl_2$, CCl_4, NaOH, C_5H_{12}, $H2_SO_4$, $Ca(OH)_2$, LiOH

33. Describe the difference between the Arrhenius theory and the Brønsted-Lowry of acids and bases.

34. According to Arrhenius theory, describe the difference between an Arrhenius acids and Arrhenius bases.

35. Of the following, pick the Arrhenius acid or bases and justify your answer: LiF, $Mg(OH)_2$, CH_3COOH, KOH, HBr, NH_3, NaCl

36. Explain why NaCl is not an acid despite the fact that it is an electrolyte.

37. Describe the general properties of acids, and the general properties of bases.

38. When the pH of a solution changes from a pH of 5 to a pH of 3, the hydronium ion concentration changes in that solution by how much? Give numbers to describe the change in concentration of each.

39. As an aqueous solution's pH changed from 7 to 11, describe how the hydronium and hydroxide ion concentration change. Give specific numbers to describe the chang ein concentration of each.

40. Which of the following pH values indicates the highest concentration of hydronium ions in a solution: 1, 2, 3, or 4. Explain.

41. Which 0.1 molar solution has a pH greater than 7? $C_6H_{12}O_6$, CH_3COOH, KCl or KOH. Explain.

42. A student dissolves a substance in water, tests the resulting solution and observes that red litmus paper turns blue. Based on this result, what can the student determine about the solution?

43. A solution of pH 11 is first tested with phenolphthalein and then with litmus paper. What is the color of each indicator of this solution?

44. According to Reference Table M, what is the color of the indicator methyl orange in a solution that has a pH of 2?

45. Describe the effect on red litmus paper of an Arrhenius base.

46. The pH of a solution is 9. What effect does the solution have on phenolphthalein? Is the solution alkaline or acidic?

47. How much 6.0 M HNO_3 is needed to neutralize 39 mL of 2.0 M KOH?

48. How much 3.0 M NaOH is needed to neutralize 30. mL of 0.75 M H_2SO_4?

49. What is the concentration of 20 mL of LiOH if it is neutralized by 60 mL of 4 M HCl?

50. What is the concentration of 60 mL of H_3PO_4 if it is neutralized by 225 mL of 2 M $Ba(OH)_2$?

51. How much 2 M HBr is needed to neutralize 380 mL of 0.1 M NH_4OH?

Factor	Affect on Rate of Solution for:	
	Solid Solutes	Gaseous Solutes
Crushing		
Stirring		
Increasing the amount of dissolved solute		
Increasing Temperature		