

AP problem set #1

Acid/Base 1987

The percentage by weight of Nitric Acid (HNO_3) in a sample of concentrated nitric acid is to be determined.

- Initially a NaOH solution was standardized by titration with a sample of potassium hydrogen phthalate ($\text{KHC}_8\text{H}_4\text{O}_4$), a monoprotic acid often used as a primary standard. A sample of pure $\text{KHC}_8\text{H}_4\text{O}_4$ weighing 1.518g was dissolved in water and titrated with the NaOH. To reach the equivalence point 26.90 milliliters of base was required. Calculate the molarity of the NaOH solution. (molecular weight: $\text{KHC}_8\text{H}_4\text{O}_4 = 204.2$)
- A 10.00 milliliter sample of the concentrated was diluted with water to a total volume of 500.00 milliliters. Then 25.00 milliliters of the diluted acid solution was titrated with the standardized NaOH solution prepared in part (a). The equivalence point was reached after 28.35 milliliters of the base had been added. Calculate the molarity of the concentrated nitric acid.
- The density of the concentrated nitric acid used in this experiment was determined to be 1.42 grams per milliliter. Determine the percentage by weight of HNO_3 in the original sample of concentrated nitric acid.

Solids liquids and solutions 1989

Consider three unlabeled bottles, each contain small pieces of one of the following metals:

Mg

Na

Ag

The following reagents are used for identifying the metals

Pure water

A solution of 1.0 M HCl

A solution of concentrated HNO₃

- a) Which metal can easily be identified because it is much softer than the other two? Describe a chemical test that distinguishes this metal from the other two, using only one of the reagents above. Write a balanced chemical equation for the reaction that occurs.
- b) One of the other two metals reacts readily with the HCl solution. Identify the metal and write the balanced chemical equation for the reaction that occurs when this metal is added to the HCl solution;. Use the table of standard reduction potential (attached) to account for the fact that this metal reacts with HCl while the other does not.
- c) The one remaining metals reacts with the concentrated HNO₃ solution. Write a balanced chemical equation for the reaction that occurs.
- d) The solution obtained in (C) is diluted and a few drops of 1 M HCl are added. Describe what would be observed. Write a balanced chemical equation for the reaction that occurs.

Equations:

Give the formulas to show the reactants and products for the following chemical reactions. Each occurs in aqueous solution unless otherwise indicated. Represent substances in solution as ions if the substance is extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. In all cases a reaction occurs.

- a) A concentrated solution of hydrochloric acid is added to solid potassium permanganate.
- b) A small piece of sodium metal is added to distilled water.
- c) Ethanol is burned in oxygen
- d) Solid barium oxide is added to distilled water
- e) Excess concentrated sulfuric acid is added to solid calcium phosphate
- f) Hydrogen sulfide gas is bubbled into a solution of mercury(II) chloride
- g) Solid calcium carbonate is strongly heated
- h) A piece of nickel metal is immersed in a solution of copper (II) sulfate
- i) Excess potassium hydroxide solution is added to a solution of aluminum nitrate