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Chapter 1 : Acid Base Titration Theory | Sciencing

THEORY OF INDICATORS: An indicator is a substance which is used to determine the end point in a titration. In acid-base titrations, organic substances (weak acids or weak bases) are generally used.

Theory[edit] In and of themselves, pH indicators are frequently weak acids or weak bases. The general reaction scheme of a pH indicator can be formulated as: The ratio of these determines the color of the solution and connects the color to the pH value. If pH is above the pKa value, the concentration of the conjugate base is greater than the concentration of the acid, and the color associated with the conjugate base dominates. If pH is below the pKa value, the converse is true. Usually, the color change is not instantaneous at the pKa value, but a pH range exists where a mixture of colors is present. This pH range varies between indicators, but as a rule of thumb, it falls between the pKa value plus or minus one. For example, if the concentration of the conjugate base is 10 times greater than the concentration of the acid, their ratio is Conversely, if a fold excess of the acid occurs with respect to the base, the ratio is 1: For optimal accuracy, the color difference between the two species should be as clear as possible, and the narrower the pH range of the color change the better. In some indicators, such as phenolphthalein , one of the species is colorless, whereas in other indicators, such as methyl red , both species confer a color. While pH indicators work efficiently at their designated pH range, they are usually destroyed at the extreme ends of the pH scale due to undesired side reactions. Application[edit] pH measurement with indicator paper pH indicators are frequently employed in titrations in analytical chemistry and biology to determine the extent of a chemical reaction. Because of the subjective choice determination of color, pH indicators are susceptible to imprecise readings. For applications requiring precise measurement of pH, a pH meter is frequently used. Sometimes, a blend of different indicators is used to achieve several smooth color changes over a wide range of pH values. These commercial indicators e. Tabulated below are several common laboratory pH indicators. Indicators usually exhibit intermediate colors at pH values inside the listed transition range. For example, phenol red exhibits an orange color between pH 6. The transition range may shift slightly depending on the concentration of the indicator in the solution and on the temperature at which it is used. The figure on the right shows indicators with their operation range and color changes.

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Chapter 2 : Theory of Indicatiors - Study Material for IIT JEE | askIITians

An acid- base indicator is dynamic equilibrium mixture of two tautomeric forms, one form is benzenoid while other is quinonoid. The two forms have different colours. Out of these one form exist in acidic sol n, while the other in alkaline sol n.

Chemistry - Chemical Principles I Acid-Base Titrations Introduction and theory When an acid reacts completely with a base, the acidic and basic properties of the solutions are destroyed neutralized. Thus, one mole of hydrochloric acid HCl aq , will neutralize one mole of sodium hydroxide, NaOH aq ; but one mole of sulfuric acid, H2SO4 aq , will neutralize two moles of sodium hydroxide. In most titrations, you would use a solution of known concentration of one substance a standard solution to determine the concentration of some other substance in a second solution. For example, you could determine what volume of hydrochloric acid of known concentration is required to neutralize a known volume of sodium hydroxide of unknown concentration. From the results obtained you could calculate the concentration of the sodium hydroxide solution. An acid-base titration is the process whereby you determine the volume of standard solution required to neutralize a solution of acid or base of unknown concentration. In these titrations, an indicator, such as phenolphthalein or cresol red, is used to determine the end-point of the titration. The end-point is the point at which equal concentrations of hydrogen ions and hydroxide ions are present in the solution. The procedure for an acid-base titration is explained below. A known volume of solution acid or base is measured out into an Erlenmeyer flask or vial by means of a pipette, and a small amount of a dye solution, called an indicator, is added. Indicators have different colours in acidic and basic solutions. Most indicators are extremely sensitive and produce a sharp change in colour when the solution changes from acidic to basic. You are probably already familiar with the use of litmus to identify acids and bases. However, in a titration an indicator is needed that gives a much more dramatic colour changes than litmus. Phenolphthalein is often used as an indicator in acid-base titrations. It is colourless in the presence of excess acid, and pink in the presence of excess base. The second solution acid if you have base in the Erlenmeyer flask, base if you have acid is poured into the burette, and the initial volume is recorded. Small amounts of this solution are then allowed to run out of the burette into the Erlenmeyer flask or vial, until the indicator changes colour. The change occurs when equal numbers of hydrogen ions and hydroxide ions are present in the Erlenmeyer flask or vial. This is not quite true. There will be a slight excess of one or other of these ions, but the excess is so small that you need not worry about it. The volume of solution remaining in the burette can be determined, and you can then calculate the volume that was added to the solution already present in the Erlenmeyer flask or vial. Once you know the volumes of acid and base used in the reaction, and the concentration of either the acid or the base, the concentration of the other can be calculated. The following example shows how such a calculation is carried out. It also shows you an acceptable method for presenting your results. Titration of a sodium hydroxide solution with standard hydrochloric acid Note: This will be the case in Part A of the present experiment.

Chapter 3 : Acidâ€“base titration - Wikipedia

The Theory of Acid-Base Indicators: Ostwald, developed a theory of acid base indicators which gives an explanation for the colour change with change in pH. According to this theory, a hydrogen ion indicator is a weak organic acid or base.

This can be very handy for determining the concentrations of acids and bases, such as hydrochloric acid and sodium hydroxide. Typically, the chemist adds a second solution, drop by drop, until the mixture suddenly changes color, signaling the end of the titration. So if the titer is a base, a chemist adds an acid as the titer. A lab technician adds a color indicator to the titer before it indicates the neutralization point. This is important because if he adds the titrant too fast, the technician can go right by the neutralization point and not know exactly how much titrant was needed to reach it. Sciencing Video Vault Indicators In acid-base titration, the neutralization point occurs at a pH of 7. Litmus is a good indicator for an acid-base titration, because it changes color at a pH of around 6. Since indicators react with the solution being measured, they should be used in moderationâ€”only a few drops if possible. The acid and base have fully canceled each other out. An example of this sort of mutual cancellation is illustrated in this chemical formula: Titration Curve If you use a pH meter, you can record pH on a regular basis as titrant is added. A plot of the pH as the vertical axis against the volume of titrant would produce a sloping curve that is particularly steep around the equivalence point. This is what makes the titration curve so steep in that one region, and therefore makes the equivalence point so easy to identify in the graph. The amount of titrant needed to neutralize the titer is therefore easy to accurately quantify. Potentiometric Titration A titration curve can also graph conductivity as the vertical axis against titrant. Acids and bases conduct electricity. Therefore, you can measure conductivity by inserting electrodes into the titer. The electrodes would be attached to a battery and ammeter or voltmeter. The titration curve will change precipitously at the equivalence point. In this case, conductivity will have a noticeable minimum at the equivalence point. This method has the benefit of not needing an indicator, which could interfere or participate in the neutralization reaction, affecting its results. What is a Titration? He has professional experience as an educator, mortgage consultant, and casualty actuary. His interests include development economics, technology-based charities, and angel investing.

Chapter 4 : Introduction and theory

This page describes how simple acid-base indicators work, and how to choose the right one for a particular titration. Litmus is a weak acid. It has a seriously complicated molecule which we will simplify to HLit. The "H" is the proton which can be given away to something else. The "Lit" is the rest.

A titrimetric method based on the formation of a slightly soluble precipitate is called a precipitation titration. The most important precipitation process in titrimetric analysis utilizes silver nitrate as the reagent Argentimetric process. Many methods are utilized in determining end points of these reactions, but the most important method, the formation of a coloured precipitate will be considered here. In the titration of a neutral solution of chloride ions with silver nitrate, a small quantity of potassium chromate solution is added to serve as the indicator. At the end point the chromate ions combine with silver ions to form the sparingly soluble brick-red silver chromate. AgCl is the less soluble salt and initially chloride concentration is high, hence AgCl will be precipitated. Once the chloride ions are over and with the addition of small excess of silver nitrate solution brick red colour silver chromate becomes visible. The titration should be carried out in neutral solution or in very faintly alkaline solution. In acid solutions following reaction occurs. Consequently the chromate ions concentration is reduced and the solubility product of silver chromate may not be exceeded. The titration can be carried out with dichlorofluorescein as the indicator. Dichlorofluorescein is an example of an adsorption indicator. Adsorption indicators have the interesting property of changing colour when they stick adsorb to the surface of a precipitate. During the titration the dichlorofluorescein molecules exist as negatively charged ions anions in solution. As the AgCl precipitate is forming, the excess Cl- ions in the solution form a layer of negative charge on the precipitate surface. The negatively charged indicator will be attracted to the positively charged precipitate surface where it absorbs and changes colour. The suspended precipitate will have a pink tinge because of some premature displacement of chloride ion by the dichlorofluorescein ion. When the pink colour starts to persist for slightly longer periods of time, the drip rate is lowered. The end point is reached when the entire solution turns pink. It is important that the AgCl precipitate be prevented from coagulation during the titration. For this reason a small amount of dextrin is added to the solution. Principle of Complexometric Titration: Complexometric titrations are particularly useful for determination of a mixture of different metal ions in solution. Ethylene diamine tetra acetic acid EDTA , is a very important reagent for complex formation titrations. EDTA has been assigned the formula II in preference to I since it has been obtained from measurements of the dissociation constants that two hydrogen atoms are probably held in the form of zwitter ions. EDTA behaves as a dicarboxylic acid with two strongly acidic groups. EDTA forms complexes with metal ions in basic solutions. In acid-base titrations the end point is detected by a pH sensitive indicator. It is the negative logarithm of the free metal ion concentration, i. Metal ion complexes form complexes with specific metal ions. These differ in colour from the free indicator and a sudden colour change occurs at the end point. End point can be detected usually with an indicator or instrumentally by potentiometric or conductometric electrometric method. There are three factors that are important in determining the magnitude of break in titration curve at end point. The stability of complex formed: The greater the stability constant for complex formed, larger the charge in free metal concentration pM at equivalent point and more clear would be the end point. The number of steps involved in complex formation: Fewer the number of steps required in the formation of the complex, greater would be the break in titration curve at equivalent point and clearer would be the end point. During a complexometric titration, the pH must be constant by use of a buffer solution. Only metals that form very stable complexes can be titrated in acidic solution, and metals forming weak complexes can only be effectively titrated in alkaline solution. Mechanism of action of indicator: During an EDTA titration 2 complexes are formed: The metal-indicator complex must be less stable than the metal-indicator complex. In the pH range the dye itself has a blue colour. In this pH range addition of metallic salts produces a brilliant change in colour from blue to red. At the end point no more free metal ions are present in the solution. At this stage, the free indicator is liberated and hence the colour changes from red to blue. Indicators used in complexometric titrations are as follows:

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Chapter 5 : ACID_BASE INDICATORS

In acid-base titration, the neutralization point occurs at a pH of Litmus is a good indicator for an acid-base titration, because it changes color at a pH of around â€”close enough, as will be explained below.

Chapter 6 : ACID BASE INDICATORS

1. Quinonoid theory: According to this theory: (a) The acid-base indicators exist in two tautomeric forms having different structures. Two forms are in equilibrium. One form is termed benzenoid form and the other quinonoid.

Chapter 7 : pH indicator - Wikipedia

An acid-base indicator is a weak acid or a weak base. The undissociated form of the indicator is a different color than the iogenic form of the indicator. An Indicator does not change color from pure acid to pure alkaline at specific hydrogen ion concentration, but rather, color change occurs over a range of hydrogen ion concentrations.

Chapter 8 : Theories of Indicators, Assignment Help, Ostwald's Theory, Quinonoid Theory

Theory of acid-base indicators: Two theories have been proposed to explain the change of colour of acid-base.