高等院校化工化学类专业系列教材

English for Chemistry and Chemical Engineering

化学化工专业英语

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About the Book

This book selects a number of breakthroughs and examples in the development of new energy technology, biotechnology, novel materials and drugs, environmental technology, and other fields. A few historic events and figures designated by the American Chemical Society as "Chemical Landmarks" are adopted. Also featured in the book are a group of original papers and patent documents in the cutting-edge fields of chemistry and chemical industry. Stories about how the chemists and engineers vigorously explored and made great inventions are described in the book. Following the texts in each unit are notes, words with pronunciations and meanings, quiz including exercises and drills for reading comprehension and short compositions, and in-class discussion themes. This book also explains in detail how to comprehend and utilize papers and patent documents, and how to write and revise papers in practice.

The book contains a significant amount of technical terminology. Lists of common glossaries with concise explanations are provided in the end of the book. Basic laboratory tools are also illustrated graphically. Records of famous chemists and engineers with their lives and areas of expertise can be used as a reference. This book serves as a textbook in bilingual education in colleges for juniors and seniors, as well as graduate students, who are non-native speakers of English but majoring in chemistry, applied chemistry, chemical engineering, materials chemistry and related disciplines. The book is also an indispensable working resource for scientists, chemists, and engineers in chemical industry and academia. This book is printed in bicolor to improve readability.

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序　言

专业英语学习带有强化训练的性质，与双语教学不同，两者不能相互替代。作为“浙江省高等学校重点建设教材”，本书旨在通过培养大学生对科学探究和发明创造的兴趣，激励学生学习好专业英语，从而为将来可能从事的企业产品开发宣传或基础研究所需的专业英语技能打好基础。本书尽力做到选材面广，趣味性、可读性强，适用面宽。

化学和化工业是一个长久不衰的行业。本书选择了在新药开发、新能源、新材料、环境保护、生物技术和现代食品业等领域中的一些突破性和创新性成果和实例，采用了被美国化学会认定评估为“化学标志性”成就的事件和人物案例，讲述了曾做出杰出贡献的化学家和工程师的勇于探索的故事，此外还精选了前沿领域中的一些原始学术论文（包含 *Nature* 和 *JACS* 等上刊登的论文）和专利文献，并对如何阅读理解和利用英语学术论文和专利文献、如何撰写及修改论文的实用方法技巧，做了非常详细的讲解。每个单元最后有课文注释，单词解析及课后练习（包含阅读理解测试和短文、摘要的写作训练，以及课堂讨论教学实例）。

本书共 28 个单元。第 1 部分共 8 个单元，主要是介绍化学化工学科的一些入门基础知识，包括化学实验和化工工艺方法、仪器工具和化合物命名等。第 2 部分共 16 个单元，内容覆盖无机化学、有机化学、分析化学、环境化学、物理化学、生物化学、高分子化学、药物开发、基础化工等，既从化学化工的历史沿革的角度，又从学科发展的热门领域的角度，介绍化学和现代化工的成就。第 3 部分共 4 个单元，介绍常见专业文献阅读和撰写技能知识，包括学术论文、国际发明专利基础知识和文献选读。第 4 部分对化学化工

各个分支领域中的常用的专业术语提供简明扼要的解释，也以图解的方式列出了基本实验工具，还对 400 多位著名化学家和工程师做了简要介绍，此部分内容可作为参考资料使用。本书配有教学辅助资料，供征订了本书的教师参考。

本书由董坚主编。他对全书做了修改和统编，并负责编写了第 5、6、7、8、16、17、18、22 和 23 单元。沈志豪对全书做了修改和校对，并负责编写了第 1、2、3、4、15 和 24 单元。倪恨美负责编写了第 19、20、25、26、27 和 28 单元，并修订了其他部分章节。王卫平负责编写了第 9、10、11 和 12 单元，并修订了其他部分章节。孙娜波负责编写了第 13、14 和 21 单元。在本书的编写过程中，美国 Case Western Reserve University (Ohio 州)的 Paul Carey 对选题提供了有益的指导，并付出了宝贵的时间对语言做了加工和润饰，在此致以衷心的感谢。美国化学会 Chemical Landmarks 项目经理 Judah Ginsberg 为本书所选用的不少标志性成就提供了参考文献，在此谨表感谢。

本书可作为高等学校的化学、应用化学、化学工程、材料化学、环境化学、轻化专业及相关专业本科学生的专业英语教材，也可作为这些专业的研究生教材，以及从事化学和化工领域的教学、科研和工程技术人员的参考书。

编　者

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Part 1

Laboratory Techniques and Chemical Nomenclature

Unit 1

Chemistry Laboratory Techniques—Recrystallization

[1] Seldom do we encounter pure materials. Instead, many materials are mixtures made up of two or more chemically different substances. In order to isolate pure components of a mixture, chemists have developed a variety of techniques for the separation of one component from another, taking advantage of the differences in physical properties of the components. Recrystallization is one of the important laboratory processes frequently used for this.

[2] Recrystallization is used to purify a solid substance at the temperature of the experiment. It is a basic purification technique based on different solubilities of solids. Insoluble impurities can be easily removed by filtration after dissolution of the solid that needs to be purified, while small amount of soluble impurities remains in the solution. Increasing the temperature produces a supersaturated solution which can be used to obtain crystals of the pure solid. When slowly cooling the solution down to room temperature, crystals form and crash out, with the impurities in the solution. Sometimes it is easier to conduct recrystallization using two solvents, one good solvent for the compound and one poor solvent.

Single-Solvent Approach

[3] A single-solvent recrystallization includes the following steps: selecting the solvent; dissolving the solid; cooling the solution; filtering and drying the crystals.

Selecting the Solvent

[4] Choosing an appropriate solvent is the first step in a recrystallization. Water, hexane, methanol, and ethyl acetate are frequently used. Ideally, the solid is virtually insoluble in the solvent at room temperature, yet is completely soluble at higher temperatures at or near the boiling point of the solvent.

To find a suitable solvent, it is necessary to test the solubility of the desired compound in different solvents. Test tubes and a rack, a test tube clamp, pipets and bulbs, a spatula, a beaker, and a hot plate are required, in addition to the compound, water, and the solvents.

5 Load a small amount of solid into a test tube, followed by adding about one milliliter of the test solvent. If the solid dissolves immediately at room temperature, the solvent is not suitable for recrystallization. Repeat this process with another test solvent using a clean test tube. If the solid does not dissolve, heat up the test tube using a hot water bath whose temperature is set at the boiling point of the test solvent. If the solid still remains, then this solvent is not good, either. Repeat with other solvents until the solid remains at room temperature, but dissolves in the solvent with the temperature at the boiling point, indicating a good recrystallization solvent.

Dissolving the Solid

6 In the second step, the solid to be recrystallized is dissolved in the hot suitable solvent. Two Erlenmeyer flasks (one for the solvent and the other for the crystals), a hot plate, a disposable pipet and bulb, finger cots, and some boiling stones are needed in this step. Place two boiling stones in each flask to ensure smooth boiling during heating. A small amount of solvent is added to a flask containing the impure solid, and then the suspension in the flask is heated to the boiling point of the solvent until the complete dissolution of the solid. If the solid does not dissolve, add more hot solvent drop-wise continually until the solid is fully dissolved. A hot filtration is required if the solution contains visible solid impurities other than boiling stones. If the solution appears colored, the hot saturated solution is boiled for a short period of time with the addition of activated carbon to remove colored impurities, followed by a hot filtration to get rid of the activated carbon.

Cooling the Solution

7 Next, the solution is cooled for the desired compound to crystallize. A more pure solid precipitates out from the solution, leaving soluble impurities in the solvent. The Noble Laureate, the late Professor Robert Burns Woodward stated that crystallization is one of the most beautiful processes known, and no true chemist fails to experience a thrill when he brings a new form of matter into the crystalline state for the first time.

8 In most cases, crystals grow as the solution cools down. Leave the solution undisturbed until the temperature decreases, and crystals begin to form on the bottom of the flask. Usually slower cooling leads to a more pure product. The size of crystals that form also depends on the cooling rate. Very small crystals tend to form upon rapid cooling and the impurities may also precipitate out of the solution along with the small crystals. Therefore, it is quite common to allow the solution to cool to room temperature first before cooling it further by setting the flask in an ice-water bath. Wait for the majority of crystals to form at room temperature and then place the flask in an ice-water bath.

9 However, sometimes crystallization needs to be induced by nucleation. One method is to scratch the flask with a glass rod at the air-solvent meniscus. The scratch increases the surface area of the glass, resulting in a roughened surface on which the solid can nucleate and crystallize. Another technique is to add a small crystal of the desired pure solid as the “seed” into the cooled solution if such a crystal is available. The “seed” crystal serves as the nucleating site for the crystal to grow.

Make sure that the solution is cool; otherwise, the added small crystal would dissolve.

[10] If there are no crystals falling out of the solution, it is possible that too much solvent has been used. The solution should be concentrated further by allowing some of the solvent to evaporate. If crystals do not immediately form, reheat and then cool the solution.

Filtering and Drying the Crystals

[11] After crystals have formed, it is time to separate them from the solution. Vacuum filtration is frequently used to isolate and dry the purified solid, sometimes washing the purified solid with chilled solvent. Use the smallest possible amount of cold solvent when washing the product to avoid dissolving some of the sample.

[12] In the apparatus shown in Fig. 1.1, vacuum is supplied by a pump and applied to the filter flask through a rubber tubing. Add filter paper to the funnel which is placed on the filter vacuum adapter in the neck of the filter flask. Use a small amount of the recrystallization solvent to moisten the filter paper and then turn on the pump. Pour and transfer the crystals and solution to the center of the filter paper. Add cold solvent to the flask and swirl the remaining crystals into the funnel.

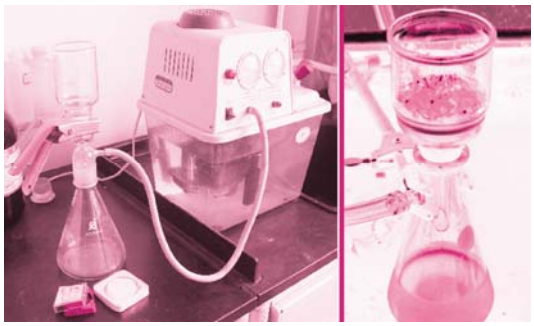

Fig. 1.1 Vacuum filtration apparatus

[13] Once the liquid is all sucked through, turn off the pump to release the vacuum. Then add a small amount of cold, clean solvent to wash the crystals and apply a gentle suction to allow the fresh solvent passing through the crystals at a slower rate. Note that suction should not be applied while washing. In order to dry the crystals as thoroughly as possible, full suction is applied for a few minutes. Drying the product via vacuum filtration should remove much of the solvent. Depending on the volatility of the solvent, sometimes open-air drying is used as well.

[14] After filtering and drying, the final step is to remove the crystals from the filter funnel. Use a spatula to transfer the crystals to a watch glass. Physically separate any remaining boiling stones from the crystals in this step. In some cases, the recrystallization process is repeated to further purify the substance.

Two-Solvent Approach

[15] When it is not possible to find a single recrystallization solvent, a two-solvent recrystallization method has to be used. In such a process, the primary solvent (Solvent A) can dissolve the desired compound at the boiling point, and the second solvent (Solvent B) should induce crystallization when added to the saturated solution of the compound in Solvent A. The same four steps are involved in a

two-solvent recrystallization: selecting the solvents; dissolving the solid; cooling the solution; filtering and drying the crystals.

Selecting the Solvents

16 Similar to the single-solvent approach, the first step is also to select suitable solvents. As mentioned above, two solvents are needed, with one being a very good solvent for the compound and the other extremely poor at room temperature. And these two solvents must be miscible.

17 A glass plate, a spatula, and several clean Pasteur pipets and bulbs are needed in this step along with a range of candidate solvents and the compound to be purified. To select the solvents, only a small amount of solid compound is needed. On a glass plate a tiny amount of the compound is placed, then about four centimeters away another sample is added. In a similar fashion place more solid samples on the glass plate until there are enough samples for the number of solvents to be chosen from. Select solvents with different polarity such as water, methanol, ethyl acetate, and hexane. Take three or four drops of one test solvent and add them to one solid sample. And repeat this process for the remaining solvents. Check the solubility results and evaluate whether the compound dissolves completely, partially, or not at all. Again, the perfect combination of solvents means that one solvent (Solvent A) easily dissolves the compound and the second solvent (Solvent B) does not dissolve the compound.

Dissolving the Solid

18 In this recrystallization approach, the two solvents A and B should also be hot. Add each solvent in an Erlenmeyer flask along with boiling stones. Then heat up the solvents until near their respective boiling points. Load the impure compound in a tared test tube that is no more than one quarter full of solid.

19 Add the first recrystallization Solvent A, to dissolve the crystals. Add just enough hot Solvent A with a Pasteur pipet to the test tube that contains the compound. During additions of Solvent A, heat and shake the test tube to help dissolve the compound. Minimum amount of hot Solvent A should be used and the volume of Solvent A should not exceed one third of that of the test tube. The second Solvent B, is then added to the solution until the solution becomes cloudy. Generally, no more than twenty drops of Solvent B is needed.

20 Alternatively, the solid can be suspended in the second Solvent B. Then hot Solvent A is added until the solid just dissolves.

21 The last two steps (cooling the solution and filtering and drying the crystals) in two-solvent recrystallization are similar to those in the single-solvent method, although here to wash the crystals in the last step, use a mixture of the solvent system in about the same ratio used to obtain a saturated solution.

Reference

L. Gattermann & H. Wieland. *Laboratory Methods of Organic Chemistry*, (tr.) W. McCartney. New York: The MacMillan Company, 1937.

Words and Expressions

recrystallization [ˌriːˈkristəlaiˈzeiʃən]
n. repeated crystallization of a material from fresh solvent to obtain an increasingly pure product

encounter [inˈkauntə]
v. 1. a) to meet as an adversary or enemy; b) to engage in conflict with; 2. to come upon face-to-face; 3. to come upon or experience especially unexpectedly
n. 1. a meeting between hostile factions or persons; a sudden often violent clash; 2. a) a chance meeting; b) a particular kind of meeting or experience with another person; 3. a coming into the vicinity of a celestial body

purification [ˌpjuərifiˈkeiʃən] *n.* the act or an instance of purifying or of being purified

supersaturated [ˌsjuːpəˈsætʃəreitid]
adj. containing an amount of a substance greater than that required for saturation as a result of having been cooled from a higher temperature to a temperature below that at which saturation occurs

spatula [ˈspætjulə]
n. a flat thin implement used especially for spreading or mixing soft substances, scooping, or lifting

cot [kɔt]
n. 1. a small house; 2. cover, sheath

precipitate [priˈsipiteit]
v. 1. to cause to separate from solution or suspension; 2. to cause (vapor) to condense and fall or deposit
n. a substance separated from a solution or suspension by chemical or physical change usually as an insoluble amorphous or crystalline solid

swirl [swəːl]
v. 1. a) to move with an eddying or whirling motion; b) to pass in whirling confusion; 2) to have a twist or convolution
n. 1. a) a whirling mass or motion; b) whirling confusion; 2. a twisting shape, mark, or pattern; 3. an act or instance of swirling

filtration [filˈtreiʃən]
n. 1. the process of filtering; 2. the process of passing through or as if through a filter

tared [tɛəd]
adj. weighed; determined; reduced to equal or standard weight

vacuum [ˈvækjuəm]
n. a volume of space that is essentially empty of matter, such that its gaseous pressure is less than atmospheric pressure

Notes

1. When dissolving the solid, add as small a quantity as possible to fully dissolve the sample. It is better to add too little solvent than too much. It is always possible to add more solvent during heating, if necessary.

2. Adding boiling stones to the flasks is important because boiling stones contain air-filled pores, which serve as sites for bubble formation preventing a heated solvent or solution from "bumping".

Quiz

1. Try to explain the following words in the text by giving their definitions or synonyms:

(1) nucleation (2) suspended (3) isolate

(4) apparatus (5) undisturbed (6) ensure

2. What is the general guideline in selecting solvents in two-solvent recrystallization?

3. How can we induce a crystallization if no crystals form when the solution is undisturbed after it is cooled?

Unit 2

Chemistry Laboratory Techniques—Acid-Base Titration

[1] A volumetric quantitative analytical technique that is often used to measure how much acid or base is present in a solution is called a titration. Acid-base titrations are based on neutralization reactions. If a solution is acidic, a titration is to add a base to it until the base neutralizes all the acid.

[2] Acid-base titrations can be used for most acids and bases, including hydrochloric acid, sulfuric acid, acetic acid, sodium hydroxide, ammonia, and so on. In particular, it is even possible to determine in one titration the composition of a mixture containing acids or bases of different strengths, such as sodium hydroxide and sodium hydrogen carbonate. Hydrochloric acid and sodium hydroxide are two most commonly used reagents in acid-base titrations.

[3] The reaction follows a stoichiometric relationship. The stoichiometric point in an acid-base titration may be visually determined by use of an indicator which tells us when the titration is completed. Visual detection of completion of the reaction is a key factor in maintaining the simplicity of titration. A visual indicator is an organic compound that changes color when the pH of the solution changes. Such pH-dependent color changes are the result of chemical changes in the indicator with its chemical environment caused by the addition of H_3O^+ or OH^-. An example of these changes in the functional moieties of phenolphthalein, a commonly used indicator which changes from colorless to a pink hue at pH 8.0−9.0, is shown in Fig. 2.1.

[4] Ideally, the observation of a sudden change in the color of the solution with the addition of a few drops of indicator tells us the completion of the titration. Sometimes color change seems like instant, with a very small drop of the titrant completely changing the color of the solution. However, depending on the concentration of titrant, titrated substance, and the selected indicator, sometimes we have to add even several milliliters of titrant before we see a color change. This confusion makes it difficult for us to determine when we should stop the titration. In some cases, we should look for a completely different indicator if the one selected fails to guarantee accuracy in the measurement. In order to choose a suitable indicator for an acid-base titration, we need to know the pH of the end point before using standard indicator tables. At the end point of the titration the pH of the solution suddenly changes. The end-point pH can be calculated with the aid of the titration equation.

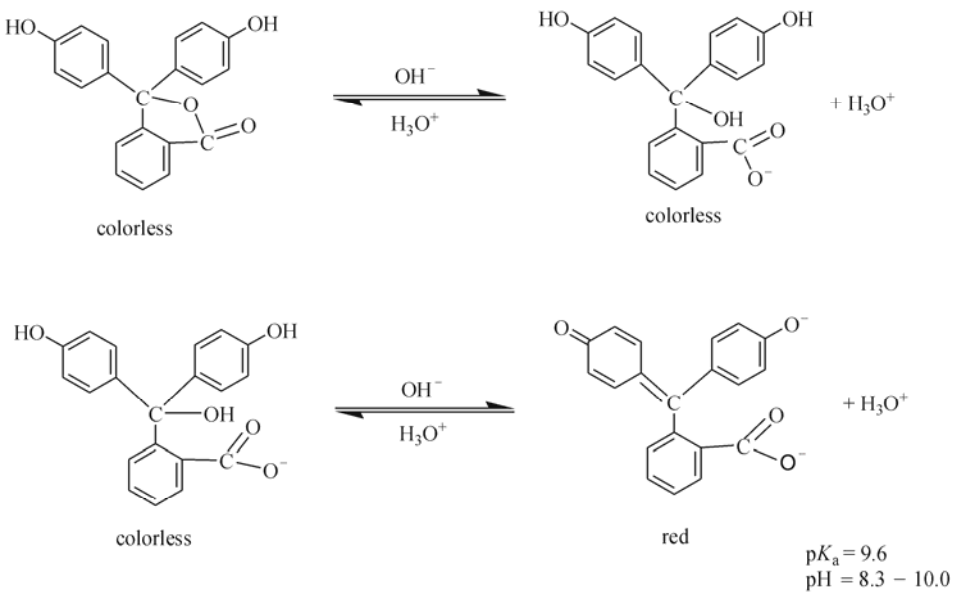

Fig. 2.1 Phenolphthalein

5 As an example to show the general procedures in an acid-base titration, sodium hydroxide solution is used to titrate a solid acid dissolved in deionized water. The end point is determined by the color change of an indictor. Fig. 2.2 shows the schematic of the titration setup.

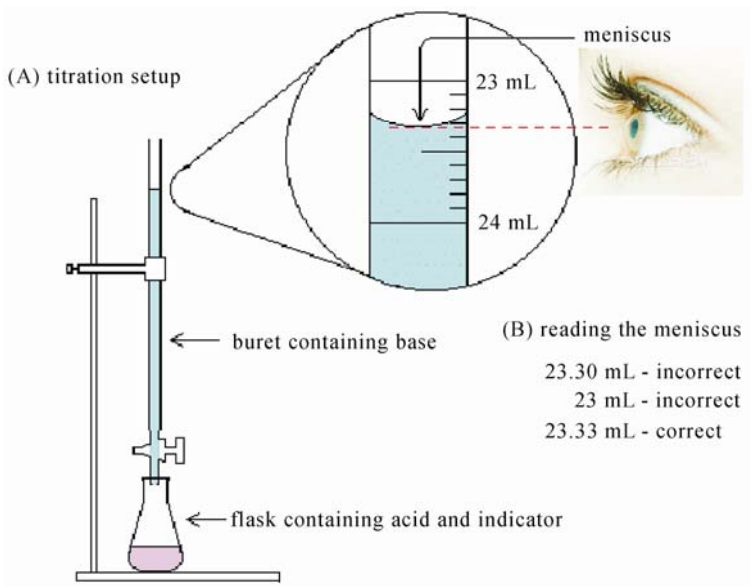

Fig. 2.2 Titration setup

6 Designed for classical quantitative volumetric analysis, this experiment serves as a good example of conducting a quantitative experiment with the combination of several quantitative techniques. It is one of the most accurate procedures yet one of the simplest in chemistry lab work. In general, a solution of the acid A is added to an Erlenmeyer flask. A buret is filled with titrant, the solution of

base B, at the beginning of the titration to its maximum capacity. The volume of the base solution is read before the beginning of the titration. Solution B is then added drop-wise from the buret to Solution A in the Erlenmeyer flask. The titration is completed when the indicator exhibits a permanent color change. The buret is read again to obtain the volume of Solution B added. With the known concentration of B in the titrant, the titrant volume that reacts with all of A in the flask can be used to calculate how much A is present based on stoichiometry. Some of the chemicals and equipment involved in this experiment include a buret, a buret clamp, a pipet, a small funnel, a standardized sodium hydroxide solution, and phenolphthalein indicator.

[7] The beginning of the acid-base titration starts with the dissolution of the solid acid sample in deionized water. Add the end-point indicator, which is phenolphthalein, with two drops to each flask containing the acid sample and deionized water. Properly label the flasks. Be consistent in all of the samples when adding the indicator. Swirl the flasks until the solid acid is completely dissolved. Finally, rinse with deionized water three times around, which is critical to ensure that all solid acid has been removed from the flask walls and dissolved in the solution. All solid particles must be dissolved prior to the titration.

[8] The buret needs to be checked for if it is quantitatively clean, both to avoid contamination and to be sure that titrant volumes are accurately read. Make sure the buret stopcock is closed. Fill the buret with water and then drain it to check the buret, making sure that its walls drain cleanly. Before checking for drainage, wait a minute or two after completely draining the buret. Sometimes droplets appear on the inner walls of the buret after some time, indicating that the buret is not quantitatively clean. In this case, it is necessary to use standard cleaning procedures to clean the buret. If the buret is droplet free, then it is quantitatively clean and can be used for titration.

[9] After the buret is cleaned, it is necessary to rinse it with the titrant, sodium hydroxide solution. Use a clean and dry funnel to add titrant to the buret. Titrant can also be poured into the buret directly with the buret removed from its holder. Small portions of titrant are used to rinse the buret in order to conserve the titrant. Hold the buret on its side and roll it to rinse the internal buret walls thoroughly. The buret tip is rinsed with the buret held over a waste container or sink and all the liquid being allowed to pass through the tip. Remove the last drop of titrant and continue with rinsing. Usually three times of rinsing is needed to remove any deionized water left in the buret.

[10] Titrant can then be filled in the well-rinsed buret. Still use a funnel to add titrant to the buret. Carefully lift the funnel for smooth delivery and to avoid overfilling of the titrant. Similar to the cleaning of the buret, an alternative is to remove the buret from the buret holder, and directly pour the titrant from the titrant bottle. Let some titrant run through the buret tip into the waste container and check whether there are any air bubbles in the tip. The bubbles will cause difficulty in obtaining accurate values of volume if they are not removed. The bubbles can be shaken out by opening the stopcock, firmly holding the buret with both hands, and jerking downward a bit. When bubbles are removed, tip off the hanging titrant drop and mount the buret for titration.

[11] With the titrant filled in the buret, the samples and the buret are ready for titration. First, the initial level of the meniscus should be read. Look directly at the meniscus, and measure the meniscus

at eye level from the center of the meniscus. It is critical to use a consistent buret reading procedure throughout the experiment. Use a contrast card to assist in reading the buret consistently. As a standard practice, the reading of the meniscus level should be immediately recorded in a permanent lab book. Taking notes on a scratch paper is not a correct way of recording such a critical observation.

12 Titration starts with sample flask number 1. Place a white paper beneath the titration flasks to aid in judging the end-point color. The buret is positioned in such a way that its tip is a few centimeters below the flask rim. The sample is titrated, using the disappearance of the indicator color as a guide of the titration rate. At the beginning of the titration, allow the titrant to run full bore into the flask. At the point where the titrant hits the acid solution the color may temporarily turn pink, but this color disappears upon swirling. The color disappearance is very rapid because of the fast production of colorless water by reaction of the base from the buret with the acid in the sample. During the titration process, continuously swirl to ensure proper mixing which leads to fast reaction.

13 As the rate of color changes slows, titrant can be added more slowly. With more sodium hydroxide from the buret added to the solution in the flask, more acid in the sample is reacted and less acid is available in the solution. When the red indicator color lingers in the flask for a second or two on swirling after addition of titrant, the end point is near and the delivery of titrant should be slowed down. Smaller volumes of titrant should be added carefully into the flask. The rapid addition rate at the start of the titration is consistent with the rapid indicator color change at the start of the titration, so is the slow addition near the end point and slow indicator color change near the equivalence point.

14 As the end point is approaching, the addition of titrant is reduced to a few drops. It requires patience and skill to locate the correct end point. Carefully watch the rate of color change. The addition should be even smaller if it takes longer for the color to fade away. Continue with ever smaller increment addition of titrant. Rinse the inner flask walls and the buret tip to make sure that no droplets remain in those places and that all the acid is in the solution. The end point is reached when the addition of a final half-drop leads to a persistent color change. The first appearance of a permanent pink coloration indicates the end point, and the solution should appear extremely pale.

15 Then read the final level of the meniscus in the buret and also record the reading immediately in the lab book. The difference between the initial volume and the volume left in the buret at the end of titration is the volume of the base consumed. It needs to be pointed out again that consistent reading of the buret is important. Be careful not to add too much titrant. If too much base is added and the indicator in the flask becomes deep pink or purple, an error called overtitration occurs. The entire titration needs to be repeated with a new sample.

16 After the first sample is done with titration, repeat the procedures for the other samples. The average value of the titrant volumes can then be used to calculate the concentration of acid in the sample with the aid of the titration equation. Note that each titration should be an independent measurement. The first or even a rough titration allows the quick determination of the approximate volume of titrant needed to neutralize the acid. Such knowledge can be used to estimate the end point for each sample. However, the predicted end point is only a guide. It should not be the target of the titration.

References

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Words and Expressions

neutralize ['nju:trəlaiz; (US) 'nu:trəlaiz]
v. 1. to make chemically neutral (pH 7.0); 2. a) to counteract the activity or effect of; make ineffective; b) to kill, destroy; 3. to make electrically inert by combining equal positive and negative quantities

stoichiometry [ˌstɔiki'ɔmitri] *n* 1. a branch of chemistry that deals with the application of the laws of definite proportions and of the conservation of mass and energy to chemical activity; 2. a) the quantitative relationship between constituents in a chemical substance; b) the quantitative relationship between two or more substances, especially in processes involving physical or chemical change

meniscus [mi'niskəs] *n.* 1. a crescent or crescent-shaped body; 2. a concavo-convex lens; 3. the curved upper surface of a column of liquid; 4. a fibrous cartilage within a joint especially of the knee

titrant ['taitrənt] *n.* a substance (as a reagent solution of precisely known concentration) that is added in titration

contamination [kənˌtæmə'neiʃən]
n. 1. a process of contaminating; a state of being contaminated; 2. contaminant

drain [drein] *v.* 1. a) to draw off (liquid) gradually or completely; b) to cause the gradual disappearance of; c) to exhaust physically or emotionally; 2. a) to make gradually dry; b) to carry away the surface water of; c) to deplete or empty by or as if by drawing off by degrees or in increments; d) to empty by drinking the contents of

jerk [dʒə:k] *v.* 1. to make a sudden spasmodic motion; 2. to move in short abrupt motions or with frequent jolts

linger ['liŋgə] *v.* 1. to be slow in parting or in quitting something; tarry; 2. a) to remain alive although gradually dying; b) to remain existent although often waning in strength, importance, or influence

fade [feid] *v.* 1. to lose freshness, strength, or vitality; wither; 2. to lose