University of Central Florida (UCF) CHM2211L Organic Laboratory Techniques I Final Practice Exam (Sample)

Study Guide

BY EXAMZIFY

Everything you need from our exam experts!

Questions

1. When a student shakes an aqueous reaction mixture with acetone in a separatory funnel, what is an expected outcome?

   A. Two distinct layers are present

   B. There are no layers present

   C. The acetone forms the bottom layer

   D. Both layers are clear

2. How can the identity of a compound after synthesis be confirmed?

   A. Spectroscopy and chromatography techniques

   B. Visual inspection only

   C. Temperature change observation

   D. Only through mass calculations

3. What is a potential effect of sodium borohydride on skin?

   A. It may cause minor irritation

   B. It causes severe skin burns

   C. It has no effect on skin

   D. Only hazardous with prolonged contact

4. When would one choose to perform a vacuum filtration?

   A. To separate two immiscible liquids

   B. To quickly separate a solid from a liquid

   C. To neutralize an acidic solution

   D. To concentrate a solution through evaporation

5. In NMR spectroscopy, what does the term "chemical shift" refer to?

   A. The change in temperature of the sample

   B. The shift in peak position relative to a reference standard

   C. The effect of external pressure on the sample

   D. The amount of light absorbed by the sample

6. In a mixture of two miscible liquids, how is the total vapor pressure calculated?

   A. By averaging the vapor pressures of the two components

   B. By summing the individual vapor pressures based on mole fractions

   C. By multiplying the vapor pressure of one component by the other

   D. By using Dalton's Law of Partial Pressures

7. What type of functional group is characterized by a carbonyl group bonded to a hydroxyl group?

   A. Alcohol

   B. Ketone

   C. Aldehyde

   D. Carboxylic acid

8. What is a primary purpose of TLC in organic chemistry?

   A. To determine boiling points

   B. To assess the purity of a compound

   C. To filter solid impurities

   D. To drive a chemical reaction

9. What does the acronym TLC represent in organic chemistry?

   A. Thin Layer Crystallization

   B. Thin Liquid Chromatography

   C. Thin Layer Chromatography

   D. Time-Linked Chromatographic method

10. Given 3.00 g of 4-aminophenol, what is the theoretical yield of acetaminophen?

   A. 2.50 g

   B. 3.80 g

   C. 4.16 g

   D. 5.00 g

Answers

1. B
2. A
3. B
4. B
5. B
6. B
7. D
8. B
9. C
10. C

Explanations

1. When a student shakes an aqueous reaction mixture with acetone in a separatory funnel, what is an expected outcome?

   A. Two distinct layers are present

   B. There are no layers present

   C. The acetone forms the bottom layer

   D. Both layers are clear

In a separatory funnel, when an aqueous reaction mixture is shaken with acetone, the expected outcome is that two distinct layers will form. This happens because acetone is less dense than water, and it is immiscible with water, providing a clear separation between the two liquids. Since acetone floats on top of the water, you would observe two clear layers: one comprising the aqueous solution and the other of acetone. This distinct layering occurs based on the differences in density and solubility of acetone compared to water. The top layer will be the acetone-rich layer, while the bottom layer will consist of the aqueous phase. Thus, the formation of two distinct layers is a fundamental principle of liquid-liquid extraction techniques in organic chemistry, demonstrating the immiscibility of the solvents used.

2. How can the identity of a compound after synthesis be confirmed?

   A. Spectroscopy and chromatography techniques

   B. Visual inspection only

   C. Temperature change observation

   D. Only through mass calculations

The identity of a compound after synthesis can be confirmed through the use of spectroscopy and chromatography techniques because these analytical methods provide detailed information about the molecular structure, composition, and purity of the synthesized compound. Spectroscopy methods, such as nuclear magnetic resonance (NMR) spectroscopy, infrared (IR) spectroscopy, and mass spectrometry, allow for the analysis of molecular structure and functional groups. For instance, NMR can provide insights into the environment of specific atoms within the molecule, while IR can identify specific functional groups based on vibrational transitions. Chromatography techniques, like gas chromatography (GC) or high-performance liquid chromatography (HPLC), are utilized to separate components of a mixture and can help assess the purity of a synthesized compound by evaluating its retention time and comparing it with known standards. Visual inspection, temperature change observations, and mass calculations may provide limited information, but they are not sufficient to definitively confirm a compound's identity or provide detailed insights into its structure and properties. Therefore, the use of advanced analytical techniques is essential in confirming the identity of a compound in a reliable and comprehensive manner.

3. What is a potential effect of sodium borohydride on skin?

A. It may cause minor irritation

B. It causes severe skin burns

C. It has no effect on skin

D. Only hazardous with prolonged contact

Sodium borohydride is a reducing agent commonly used in organic chemistry, particularly for reducing carbonyl compounds. When it comes to its effects on skin, it is important to accurately understand its reactivity and potential hazards. The correct understanding highlights that sodium borohydride can cause skin irritation due to its alkaline nature and the potential for chemical reactions upon contact with moisture, including sweat on the skin. Such interactions can lead to discomfort or irritation but typically do not result in severe skin burns under normal exposure conditions. Severe burns are more commonly associated with stronger corrosives such as strong acids or bases. Although prolonged contact with sodium borohydride can increase the likelihood of irritation, stating that it causes severe burns does not accurately reflect its typical interactions with skin tissues. Therefore, recognizing that sodium borohydride may cause minor irritation is the most appropriate conclusion regarding its potential effects on skin.

4. When would one choose to perform a vacuum filtration?

A. To separate two immiscible liquids

B. To quickly separate a solid from a liquid

C. To neutralize an acidic solution

D. To concentrate a solution through evaporation

Vacuum filtration is a technique that utilizes reduced pressure to facilitate the rapid separation of solids from liquids. It is particularly effective when you have a mixture containing a solid that needs to be isolated from a liquid phase, such as during the purification of a product following a reaction. The vacuum pulls the liquid through a filter, allowing the solid to remain on the filter paper, which is much faster than gravity filtration. In contexts where there is a need to speed up the filtration process, such as when dealing with fine precipitates that would take a long time to filter by gravity, vacuum filtration becomes the preferred method. This technique is not suitable for separating immiscible liquids, neutralizing solutions, or concentrating solutions through evaporation, as those tasks utilize different laboratory techniques that are more appropriate for the specific separation or manipulation required.

5. In NMR spectroscopy, what does the term "chemical shift" refer to?

A. The change in temperature of the sample

B. The shift in peak position relative to a reference standard

C. The effect of external pressure on the sample

D. The amount of light absorbed by the sample

The term "chemical shift" in NMR (Nuclear Magnetic Resonance) spectroscopy specifically refers to the shift in peak position relative to a reference standard. This shift occurs due to the electronic environment surrounding the nuclei of atoms in a molecule, which affects their resonance frequency when exposed to a magnetic field. The presence of electronegative atoms, aromatic systems, or different bonding environments alters the local magnetic field experienced by the nuclei, leading to distinct chemical shifts that allow for the identification of different functional groups and the environment of specific hydrogen or carbon atoms in organic compounds. This concept of referencing to a standard, often tetramethylsilane (TMS) is crucial, as it provides a consistent basis for measuring and comparing chemical shifts across different samples and experiments. Understanding chemical shifts is fundamental for interpreting NMR spectra and elucidating the structure of organic molecules.

6. In a mixture of two miscible liquids, how is the total vapor pressure calculated?

A. By averaging the vapor pressures of the two components

B. By summing the individual vapor pressures based on mole fractions

C. By multiplying the vapor pressure of one component by the other

D. By using Dalton's Law of Partial Pressures

The total vapor pressure of a mixture of two miscible liquids is calculated by summing the individual vapor pressures of each component, which are weighted by their respective mole fractions in the mixture. This method is derived from Raoult's Law, which states that the partial vapor pressure of each component in a solution is proportional to its mole fraction in the liquid phase. For each component, the partial vapor pressure is determined by multiplying the vapor pressure of that pure component by its mole fraction in the mixture. The total vapor pressure is then the sum of these partial pressures. This approach effectively captures how the presence of one liquid influences the evaporation of the other, leading to a total vapor pressure that reflects the composition of the mixture. Using average values, multiplying pressures, or applying Dalton's Law directly does not accurately represent the behavior of miscible liquid mixtures, particularly since the interactions between the components can alter the individual vapor pressures. Therefore, summing the individual vapor pressures based on their mole fractions provides the correct method for calculating the total vapor pressure in a miscible liquid mixture.

7. What type of functional group is characterized by a carbonyl group bonded to a hydroxyl group?

A. Alcohol

B. Ketone

C. Aldehyde

D. Carboxylic acid

The functional group characterized by a carbonyl group (C=O) bonded to a hydroxyl group (—OH) is known as a carboxylic acid. This particular structure is important because it consists of both the carbonyl and hydroxyl parts, which gives carboxylic acids their distinctive acidic properties. The presence of the carbonyl group contributes to the reactivity of the compound, while the hydroxyl group enhances solubility in water and also plays a role in hydrogen bonding. Carboxylic acids are typically found in many biological compounds and play significant roles in various biochemical processes. This combination of functional groups not only defines their structure but also influences their behavior and reactivity in organic chemistry, distinguishing them from other functional groups such as alcohols, ketones, and aldehydes.

8. What is a primary purpose of TLC in organic chemistry?

A. To determine boiling points

B. To assess the purity of a compound

C. To filter solid impurities

D. To drive a chemical reaction

In organic chemistry, the primary purpose of Thin Layer Chromatography (TLC) is to assess the purity of a compound. This technique works by separating the components of a mixture based on their different affinities for the stationary phase (the TLC plate) and the mobile phase (the solvent used to elute the compounds). When a sample is applied to a TLC plate and developed, the distinct spots or bands that appear correspond to different substances within the sample. By analyzing the number of spots and their relative intensities, chemists can evaluate how many components are present in the sample and whether impurities are present. A pure compound will typically produce a single spot, while a mixture or impure compound will show multiple spots. Additionally, TLC can be used to compare the Rf values (the ratio of the distance traveled by the compound to the distance traveled by the solvent front) of the sample with known standards to help identify the compound. Other options do not accurately reflect the primary role of TLC. Determining boiling points, filtering solid impurities, and driving chemical reactions are tasks handled by other techniques and methods in organic chemistry, such as distillation or filtration, rather than TLC.

9. What does the acronym TLC represent in organic chemistry?

A. Thin Layer Crystallization

B. Thin Liquid Chromatography

C. Thin Layer Chromatography

D. Time-Linked Chromatographic method

The acronym TLC in organic chemistry stands for Thin Layer Chromatography. This technique is widely used for the separation and analysis of organic compounds. It involves applying a small sample on a thin layer of adsorbent material, typically silica gel or alumina, which is coated on a flat surface or plate.   In Thin Layer Chromatography, a solvent or solvent mixture is used to develop the layers by capillary action. As the solvent moves up the plate, it carries the components of the sample with it at different rates, based on their affinities for the stationary phase (the adsorbent) versus the mobile phase (the solvent). This results in the formation of distinct spots on the plate, each representing different components of the mixture. After development, the spots can be visualized, often with a UV lamp or staining, allowing for qualitative analysis and even quantification of the compounds.   Understanding TLC is critical for organic chemists as it provides a rapid and efficient means of monitoring reactions, determining purities, and even identifying compounds based on retention factors.

10. Given 3.00 g of 4-aminophenol, what is the theoretical yield of acetaminophen?

A. 2.50 g

B. 3.80 g

C. 4.16 g

D. 5.00 g

To determine the theoretical yield of acetaminophen from 4-aminophenol, first, we need to consider the balanced chemical equation for the reaction that converts 4-aminophenol to acetaminophen. Typically, this conversion involves the acetylation of 4-aminophenol using acetic anhydride or acetyl chloride.   In the reaction, one mole of 4-aminophenol will yield one mole of acetaminophen. Therefore, the stoichiometry is 1:1. We start by calculating the moles of 4-aminophenol present: 1. Calculate the molar mass of 4-aminophenol ($C6H7NO$):   - Carbon (C): 12.01 g/mol x 6 = 72.06 g/mol   - Hydrogen (H): 1.008 g/mol x 7 = 7.056 g/mol   - Nitrogen (N): 14.01 g/mol x 1 = 14.01 g/mol   - Oxygen (O): 16.00 g/mol x 1 = 16.00 g/mol   - Total molar mass = 72.06 + 7.