Synthesis of an Ester

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**An ester is synthesized out of a carboxylic acid and an alcohol, in this experiment propanol and propanoic acid were used to form propyl propanoate. Using a hot plate and reflux apparatus, the reagents can mix in the presence of a catalyst (H2SO4) without evaporation occurring. By mixing the ester with an ether and water, the soluble with attract with eachother, and the same with the insoluble, making it easy to separate. After separation and purification from evaporation, you can determing the percent yield of pure ester, which is 0.468%. The purpose of the experiment was to synthesize an ester and smell the fruity smell that esters create, which both were accomplished.**

**introduction**

An ester is made from synthesizing and purifying the mixture of a carboxylic and and an alcohol. Esters can be made from several different variations of acids and alcohols, and each different mixture will give off a different fruity smell. The ester being synthesized in this experiment is propyl propanoate, which is synthesized from propanol and propanoic acid and should give off the smell of a pineapple. When synthesizing an ester it is important that you use one of the reagants in threefold excess to drive the equilibrium off. In this experiment, the alcohol will be used in excess. The goal is to synthesize 20 mmoles of propyl propanoate. Thus, 20 mmoles of propanoic acid and 60 mmoles of propanol will be used. To find out the goal weight in grams of each reagent to use we will use this equation:

Grams of reagent = MW (grams/mole) x 2.0 x 10-2 moles **Equation 1**

|  |  |  |
| --- | --- | --- |
|  | *Molecular weight* | *Grams needed* |
| *Propanol (threefold)* | 60.10 g/mol | 1.202 x 3 = 3.606 grams |
| *Propanoic Acid* | 74.08 g/mol | 1.482 grams |

From the molecular weights of the reagants used, the molecular weight of our ester being synthesized (116.1 g/mol), and the weight pre and post evaporation, you can determine the percent yield pure ester.

**materials & methods**

**Apparatus.** The materials used in this experiment are a reflux apparatus, stirring capsule, wool and sand bath, hot plate, a separatory funnel, and beakers.

**Reagents.** The reagents used are propanol, propanoic acid, sulfuric acid (H2SO4) as our catalyst, ethyl ether to separate the soluble from insoluble, and water. Preparation includes setting up the reflux apparatus to prevent evaporation, and gathering needed amount of reagents used to synthesize our ester.

**Safety Considerations.** The reflux apparatus is made of glass and can break if not carefully handled. A hot plate will also be used, so be aware of it when working around and keep loose items away from it. When boiling the reagents, make sure the mixture does not dry out.

**Procedures.** After collecting our supplies and putting together our reflux apparatus, the propanol, propanoic acid, 3 drops of sulfuric acid, and boiling stone is placed in the sand bath and wrapped with wool. After heating, allow time to cool and place contents in the seperatory funnel. Add 10mL of ethyl ether and water, shake, and allow to separate. Drain the H20 and water soluble mix that is on the bottom off into a separate clean beaker. Repeat this step two times to wash the mixture completely. The remaining solution is the ester/ether mix which will be drained into a clean beaker and given time to evaporate the ether off, leaving us with our pure ester.

**results & discussion**

The weights determined needed of the propanol and propanoic acid were very close to the actual weight measured. (Table 1) The following weights were obtained before, during, and after the experiment and will be utilized when determing percent yield of pure ester. (Table 2)

**Table 1**

|  |  |  |
| --- | --- | --- |
| Reagent | Goal weight | Actual weight |
| Propanol | 3.606 g | 3.605 g |
| Propanoic Acid | 1.482 g | 1.487 g |

**Table 2**

|  |  |  |
| --- | --- | --- |
|  |  | Reagent alone |
| Weight of empty beaker | 28.589 g | - |
| Weight of beaker with ester/ether mix | 35.757 g | 7.168 g |
| Weight of beaker with evaporated pure ester | 28.600 g | 0.011 g |

This experiment was pretty straight forward and was completed with no noticeable errors. Once our ester was purified, the percent yield can be determined by finding out how many mmol were actually used in the synthesis and the mmol of the ester synthesized. The number of moles to be synthesized was 20.1 mmole, which is extremely close to the goal of 20 mmol. The amount of purified ester is 0.095 mmole. By dividing the actual yield by the theoretical yield, the percent yield is determined to by 0.468%.

**conclusion**

In this experiment, by combining an alcohol and a carboxylic acid, a ester was able to be formed. After separating and allowing time for evaporation and purification, the percent yield of pure ester was able to be determined. The percent yield was 0.468%, which is believed to be fairly accurate due to the amount of ester synthesized and the pure ester amount. The purpose of the experiment was to synthesize an ester out of a carboxylic acid and an alcohol and the product should have a pineapple smell to it. Our product didn’t have an obvious pineapple smell to it, but did have a hint of a fruity smell, which is most likely due to having so little sample to work with, as well as the stuffy nose I have had.